

SAN FRANCISCO PUBLIC LIBRARY



3 1223 10225 4365

5/S



San Francisco Public Library

Government Information Center
San Francisco Public Library
100 Larkin Street, 5th Floor
San Francisco, CA 94102

REFERENCE BOOK

Not to be taken from the library

3 1223 10225 4365

CITY AND COUNTY OF SAN FRANCISCO
DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING

STANDARD SPECIFICATIONS

FOR CONSTRUCTION OF
STREETS AND HIGHWAYS
SEWERS AND DRAINAGE
STRUCTURES
ELECTRICAL WORK
AUXILIARY WATER SUPPLY SYSTEM



ISSUED BY
DEPARTMENT OF PUBLIC WORKS
H. C. VENSANO, DIRECTOR
BUREAU OF ENGINEERING
RALPH G. WADSWORTH, CITY ENGINEER

MARCH 1947

TABLE OF CONTENTS

	Page
PART I GENERAL STIPULATIONS.....	7
PART II MATERIALS.....	40
PART III STREETS AND HIGHWAYS.....	71
PART IV SEWERS AND DRAINAGE.....	104
PART V STRUCTURES AND MISCELLANEOUS.....	121
PART VI ELECTRICAL WORK.....	141
PART VII AUXILIARY WATER SUPPLY SYSTEM FOR FIRE PROTECTION.....	153

PART I. GENERAL STIPULATIONS

Section

1 Definition of Terms.....	7
2 Instructions and Information for Bidders.....	9
3 Award and Execution of Contract.....	16
4 Progressive Payments	16
5 Extensions of Time and Liquidated Damages for Delays..	17
6 Interpretation of Specifications.....	19
7 Legal Relations and Responsibility.....	20
8 Control of the Work.....	22
9 Prosecution and Progress of the Work.....	24
10 Measurement and Payment.....	35

PART II. MATERIALS

20 Portland Cement.....	40
21 Hydrated Lime	41
22 Diatomaceous Earth.....	41
23 Sand or Fine Aggregate.....	41
24 Rock or Coarse Aggregate.....	42
25 Water	43
26 Lamp Black	43
27 Mortar, Grout	43
28 Concrete	44
29 Curb Bar.....	48
30 Emulsified Asphalt	48
31 Asphaltic Cement	49
32 Stone Dust	50
33 Expansion Joint Filler.....	50
34 Bituminous Sewer Joint Compound.....	51
35 Common Brick.....	51

PART II. MATERIALS (Continued)

Section	Page
36 Vitrified Brick.....	51
37 Paving Brick	52
38 Vitrified Clay Pipe.....	52
39 Drain Tile.....	52
40 Corrugated Metal Pipe.....	53
41 Cast Iron.....	55
42 Cast Steel	56
43 Structural, Rivet and Eyebar Steel.....	57
44 Wrought Iron.....	57
45 Reinforcing Steel.....	58
46 Cast Iron Pipe and Fittings.....	60
47 Welded Wrought-Iron Pipe.....	60
48 Lumber and Timber.....	61
49 Timber Piles.....	70

PART III. STREETS AND HIGHWAYS

100 Grading.....	71
101 Subgrade for Pavement.....	73
102 Concrete Curb, Armored.....	75
103 Concrete Curb, Unarmored.....	77
104 White Concrete Curb.....	78
105 Combined Curb and Gutter.....	78
106 Stone Curb	80
107 Redwood Curb.....	80
108 Concrete Sidewalk — Two Course.....	81
109 Concrete Sidewalk — One Course.....	82
110 Redwood Headers.....	83
111 Concrete Pavement.....	83
112 Concrete Base, Type A.....	87
113 Concrete Base, Type B.....	88
114 Concrete Center Strip Pavement.....	90
115 Brick Pavement.....	91
116 Spray Coat	93
117 Asphaltic Concrete Wearing Surface.....	93
118 Asphaltic Concrete Base (Black Base).....	97
119 Waterbound Macadam.....	98
120 Oiled Surface for Macadam.....	100
121 Emulsified Asphalt Armor Coat.....	101
122 Macadam Sidewalk.....	103

Table of Contents

PART IV. SEWERS AND DRAINAGE

Section	Page
150 Excavation.....	104
151 Sheet Piling, Lagging and Bracing.....	105
152 Disposal of Seepage, Storm Water and Sewage.....	105
153 Subdrains.....	106
154 Reinforced Concrete Sewers and Sewer Structures.....	106
155 Y-Branches and Stub Inlets.....	108
156 Connections with Existing Sewers, Side Sewers, and Culverts.....	109
157 Vitrified Clay Pipe Sewers.....	109
158 Side Sewers.....	112
159 V.C.P. Culverts.....	113
160 C.M.P. Culverts.....	113
161 Tile Drains.....	114
162 Manholes.....	114
163 Lampholes.....	116
164 Catchbasins and Storm Water Inlets.....	116
165 Moving and Reconstructing Catchbasin.....	118
166 Abandoned Sewers and Structures.....	118
167 Backfilling.....	167
168 Restoring Pavements.....	119

PART V. STRUCTURES AND MISCELLANEOUS

200 Creosoting Timber and Piles.....	121
201 Galvanizing.....	123
202 Timber Structures.....	123
203 Precast Concrete Piles.....	124
204 Driving Piles.....	125
205 Concrete Structures.....	127
206 Dry Rubble Walls.....	134
207 Mortared Rubble Walls.....	135
208 Steel Structures.....	135
209 Painting.....	136
210 Test Borings.....	139

PART VI. ELECTRICAL WORK

250 Scope and Rules and Regulations.....	141
251 Electrical Inspection.....	141
252 Electrical Materials.....	141
253 Installation of Electrical Equipment.....	144
254 Electrical Tests.....	152

PART VII. AUXILIARY WATER SUPPLY SYSTEM FOR FIRE PROTECTION

CHAPTER I. GENERAL PROVISIONS

Section	Page
300 Scope.....	153
301 General Requirements.....	153
302 Handling of Materials.....	154
303 Patterns, Templates, Gauges.....	156

CHAPTER II. MATERIALS

310 Cast Iron Pipe.....	157
311 Gate Valves and Check Valves.....	162
312 Standard High Pressure Hydrants.....	166
313 Cast Steel, Special Castings.....	169
314 Cast Iron, Special Castings.....	171
315 Castings for Valve Vaults, Valve Boxes, Shields.....	173
316 Bolts, Tie Rods, Turnbuckles, etc.....	174
317 Pig Lead.....	174
318 Yarn.....	175

CHAPTER III. INSTALLATION

330 Excavation.....	176
331 Laying Pipe.....	177
332 Installing Valves.....	180
333 Air Valves.....	180
334 Installing Hydrants.....	180
335 Installing Fire Boat Wharf Manifolds.....	181
336 Valve Boxes.....	182
337 Valve Vaults.....	182
338 Hydrostatic Field Tests.....	182
339 Concrete Slab Over Trench.....	184
340 Melting Joints.....	184
Index.....	185

PART I
GENERAL STIPULATIONS
SECTION 1
DEFINITIONS OF TERMS

Whenever, in these Standard Specifications or elsewhere in the contract, the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows:

A.A.S.H.O.—The American Association of State Highway officials. All references to the specifications of the A.A.S.H.O. are understood to refer to the current specifications as revised or amended at the date of receipt of bids.

A.S.T.M.—The American Society for Testing Materials. All references to the specifications of the A.S.T.M. are understood to refer to the current specifications as revised or amended at the date of receipt of bids.

Approximate, Approximately.—The use of these words shall be interpreted as meaning subject to possible variation in quantity or dimension, with no restriction whatever on the amount or extent of such variation.

Bidder.—Any individual, firm, copartnership, or corporation submitting a proposal in response to the advertisement calling for proposals or bids on the work contemplated in the specifications.

Cement; Concrete.—Portland cement, and Portland cement concrete, unless otherwise designated or shown by the context.

Charter.—The Charter of the City and County of San Francisco as adopted March 26, 1931, (in effect, January 8, 1932,) including subsequent revisions and amendments thereto.

City.—The City and County of San Francisco, State of California.

City Engineer or Engineer.—The City Engineer of the City and County of San Francisco, State of California, acting directly or through properly authorized agents limited by the particular duties entrusted to them.

Contract.—The written agreement covering the performance of the work. The contract includes the advertisement calling for bids, the proposal, plans, specifications, contract bonds, and all supplemental agreements affecting the work.

Contract Cost.—The aggregate amount or price promised to be paid by the City to the Contractor upon fulfillment of the contract,

Section 1

or such aggregate amount adjusted as provided in Section 10 (b), herein. The aggregate amount is the lump sum or total of lump sums bid in the proposal, or is the sum of the products of the number of units of work in each class, as shown in the proposal, multiplied by the respective unit prices bid in the proposal.

Contractor.—The person or persons, firm, copartnership, or corporation who, as party or parties of the first part, has or have entered into the contract with the City, or his, their, or its duly authorized representative.

Date of Acceptance.—The date on which the Director approves the Order of the Department of Public Works accepting the work and authorizing the issuance of a certificate of satisfactory completion and acceptance.

Day.—Calendar day, any and every day shown on the calendar, Sundays and holidays included.

Department of Public Works or Department.—The Department of Public Works of the City and County of San Francisco, State of California, acting directly or through properly authorized agents limited by the particular duties entrusted to them.

Director of Public Works or Director.—The Director of Public Works of the City and County of San Francisco, State of California, acting directly or through properly authorized agents limited by the particular duties entrusted to them.

Inspector.—The Inspector or Inspectors of the Bureau of Engineering, of the Department of Public Works, of the City and County of San Francisco, State of California, limited by the particular duties entrusted to him or them.

Plans.—The drawings, or reproductions thereof, approved by the Engineer, pertaining to the work and made a part of the contract.

Provided, Specified.—Provided, specified, under the specifications or contract.

Section; Subdivision.—The numbered sections, and the lettered subdivisions thereof, into which the material in these Standard Specifications is divided and arranged unless the context or reference indicates otherwise.

Specifications.—The information, directions, provisions and requirements pertaining to the work, and contained in these Standard Specifications, in the Special Provisions, and all supplemental agreements under the contract.

The Special Provisions are the special body of directions, terms, provisions and requirements prepared to cover the work in such particulars as are not anticipated nor satisfactorily provided for in these Standard Specifications.

The Work.—The improvement, structure, project, or construction contemplated in the contract, the furnishing of all necessary labor, materials, tools and other devices, and the doing or performing by the Contractor of all things required to be done for the fulfillment of the contract as provided therein.

Ton.—Short ton of two thousand pounds.

SECTION 2

INSTRUCTIONS AND INFORMATION FOR BIDDERS

(a) Cash Deposit For Specifications.—Specifications and Plans can be obtained at the Central Permit Bureau, City Hall, on payment for each set, of the cash deposit specified in the advertisement inviting proposals. When no amount is so specified, the cash deposit shall be ten dollars. Unless otherwise specified in the advertisement, the cash deposit will be refunded upon return of the plans and specifications in good condition within thirty days after the receipt of bids. Plans and Specifications not so returned shall be considered as sold for the amount of the deposit, and no refund will be made in such case.

(b) Proposals.—Each bid shall be enclosed in a sealed envelope addressed to the Director of Public Works and endorsed with the superscription indicated on the cover of the Specifications.

All proposals or bids must be made in ink upon the official forms, including schedule of bid prices, which may be obtained at the office of the Department of Public Works, and must be handed in, together with the original sub-bids, as required by subdivision (n) of this Section below, within the hour named in the advertisement.

Each bidder shall insert on the bid sheet the price or prices for which he will do the required work and furnish all the required materials in accordance with the provisions of the specifications, and to the satisfaction of the Director of Public Works.

Bids with alterations or erasures therein shall be rejected.

Any statement accompanying and tending to qualify a bid shall cause rejection of such bid, unless such statement is required in a proposal embracing alternative bids.

Unless otherwise specified, bidders shall bid on all items included in the proposal. In determining the low bidder, only the grand total of all bid items will be considered. No award will be made on individual bid items.

When, in the opinion of the Director of Public Works, the prices in any proposal are obviously unbalanced, such proposal shall be rejected.

Bids received from bidders to whom plans and specifications have not been officially issued will be disregarded.

All bids received as herein provided will be opened and publicly

Section 2

read by the Director upon the expiration of the hour named in the advertisement. After tabulation, bidders may inspect the bids.

(c) Collusion.—The attention of all bidders is drawn to the provisions of Section 100 of the Charter of the City, which provides for the annulment and voiding of the contract, if any party or parties to whom a contract has been awarded, has or have been guilty of collusion.

No person, corporation or firm will be allowed to make, file, or be interested, as a principal, in more than one proposal or bid for the work, and each bidder must make the affidavit for which a form is printed on the proposal blank.

(d) Estimate of the Amount of Work to be Done.—The amount of work included in a lump sum bid is shown in the specifications and plans. The amount of each class of work included in a unit price bid has been preliminarily estimated, as shown on the schedule of bid prices in the proposal, and this estimate will be used as a basis for comparing bids. The Director does not expressly, or by implication, agree that the actual amount of work will correspond with the amount so shown or estimated, but reserves the right to increase or decrease the amount of any class or portion of the work, to leave out an entire item or items, or to add work of a class not included in the proposal, when in his judgment such change is to the interest of the City. No such change in the work shall be considered as a waiver of any condition of the contract, nor shall any such change invalidate any of the provisions thereof.

(e) Bidders Must Make Thorough Investigation.—Bidders must satisfy themselves of, and determine for themselves, all the circumstances and conditions affecting the cost of the proposed work, by personal examination of the site of the work, of the plans and specifications, and by such other means as they may choose.

It is understood that information as to underground, or other, conditions or obstructions indicated in the plans or specifications has been obtained with reasonable care, and has been recorded in good faith. There is no expressed or implied agreement that such information or the depths, character of materials or water conditions are correctly shown, and bidders must take into account the possibility that conditions affecting the cost or quantities of work may differ from those indicated.

Certain records of the locations in public streets of the various Public Utility Companies' pipes, conduits, and other structures, are on file in the City Engineer's Office and may be inspected by bidders. No representation is made as to the accuracy or completeness of these records, and bidders are instructed to apply for further information to the Company or Companies concerned.

(f) Additional Information Prior to Receipt of Bids.—If it should appear to a bidder that the work to be done, or any of the matters relative thereto are not sufficiently described or explained

in the specifications, or that any discrepancy exists between different parts of the specifications, or that the full intent of the specifications is not clear, then the bidder shall make written inquiry regarding same at the office of the City Engineer at least three days before the time set for opening of bids. If, in the opinion of the City Engineer, additional information is necessary, such information will be contained in an addendum. This addendum will be delivered to all individuals, firms and corporations having sets of specifications out for the purpose of preparing bids, and shall have the same binding effect as though clauséd in the main body of the specifications. Interpretation of plans and specifications will not be given before award of contract, if inquiry is made less than three days before the time set for the opening of bids.

The City will not be responsible for oral instructions or information, concerning the specifications or the work, given out by its officers, employees or agents to prospective bidders.

(g) Bid Prices to Cover Entire Work.—Bidders must include in their bid prices the entire cost of the work contemplated in the contract, and it is understood and agreed that there is included, in each lump sum or unit price bid, the entire cost of all work incidental to the completion of that portion of the work covered by such lump sum or unit price bid, unless such incidental work is expressly included in other lump sum or unit price bids in the proposal.

When a bidder is in doubt as to the proper item to which to allocate the anticipated cost of any incidental portion of the work, he shall include such cost in the lump sum or unit price bid for such item as he may deem most appropriate.

(h) Certified Check to Accompany Proposal.—Each proposal must be accompanied by a certified check on a solvent bank in the State of California, payable on sight to the City and County of San Francisco, for an amount equal to not less than 10 per cent of the total amount of the bid. When award of contract is made, all checks will be returned to the respective bidders except that filed with the accepted bid or proposal, which check will be returned upon the signing of the contract and filing of the required bonds.

When the work proposed to be done under the contract is subdivided into more than one proposition and the form of proposal affords the bidder the opportunity to bid on an optional amount of the total work, the certified check specified above shall be for an amount not less than 10 per cent of the total price of the maximum amount of work that can be awarded to the bidder in accordance with his proposal.

(i) Qualifications of Bidders.

Contractor's Registration.—The attention of bidders is drawn to the provisions of the San Francisco Contractor's Registration Ordinance No. 9.0924. No award of the contract shall be made to any contractor whose name, together with the names of his sub-con-

Section 2

tractors, does not appear on the Register of Contractors at the time bids are received.

Each bidder shall insert the number of his contractor's State license, as well as the number of his certificate of registration under the above ordinance, in the spaces provided for this purpose on the Proposal form. Failure to comply with this requirement shall invalidate the Proposal.

Bidders' Experience and Financial Qualifications.—In accordance with the provisions of Section 40 of Chapter X, Part II of the San Francisco Municipal Code, all bidders are hereby required to furnish to the Director, information concerning their experience and financial qualifications. This information will be taken into consideration in the award of the contract.

The required information shall be furnished on the official form entitled "Contractor's Statement of Financial Condition," copies of which may be obtained at the Office of the Director.

This statement, the life of which shall be one year, will be retained by the Director in a secret file and its contents will be considered confidential.

No bid will be received by the Director from a Contractor unless the Contractor has filed a statement, as required above, within the period of one year next preceding the date of receipt of bids.

(j) Contractor's Working Conditions.—The attention of bidders is drawn to Section 98 of the Charter of the City and County of San Francisco, the provisions of which apply to the work under this contract, and which reads in part as follows:

"Every contract for any public work or improvement to be performed at the expense of the city and county, or paid out of moneys deposited in the treasury, whether such work is to be done directly under contract awarded, or indirectly by or under sub-contract, sub-partnership, day labor, station work, piece work, or any other arrangement whatsoever, must provide: (1) That in the performance of the contract and all work thereunder, eight hours shall be the maximum hours of labor on any calendar day; (2) that any person performing labor thereunder shall be paid not less than the highest general prevailing rate of wages in private employment for similar work; (3) that any person performing labor in the execution of the contract shall be a citizen of the United States; (4) that all laborers employed in the execution of any contract within the limits of the city and county shall have been residents of the city and county for a period of one year immediately preceding the date of their engagements to perform labor thereunder; provided, however, that the officer empowered to award any such contract may, upon application of the contractor, waive such residence qualifications and issue a permit specifying the extent and terms of such waiver whenever the fact be established that the required number of laborers and mechanics possessing qualifications required by the work to be done cannot be engaged to perform labor thereunder.

"The term 'public work' or 'improvement,' as used in this section, shall include the fabrication, manufacturing or assembling of materials in any shop, plant, manufacturing establishment or other place of employment, when the said materials are of unique or special design, or are made according to plans and specifications for the particular work or improvement, and any arrangement made for the manufacturing, fabrication or assembling of such materials shall be deemed to be a contract or a sub-contract subject to the provisions of this section."

(k) Workmen's Compensation Insurance.—Before the execution of the contract the successful bidder shall furnish proof satisfactory to the Director that said bidder has taken out full compensation insurance for the period covered by the contract. Such insurance shall be in accordance with the provisions of the Act of the Legislature of the State of California, known as the "Workmen's Compensation Insurance and Safety Act," approved May 26, 1913, and all acts amendatory thereof and supplemental thereto. The Contractor shall maintain such insurance in full force and effect during the life of the contract.

Should any accident or death occur to any employee for which the employee, or his dependents, in the event of his death, is entitled to compensation from the City under the provisions of said Act, or for which compensation is claimed from the city, the City will retain out of the sums due the Contractor, under this contract, an amount sufficient to cover such compensation, as fixed by said Act, as amended, until such compensation shall have been paid, or until it shall have been determined that no compensation is due, and in case the City, under said Act as amended, shall be compelled to pay such compensation, it will deduct and retain from such sums the amount of such compensation so paid by it.

In the event that the Contractor shall fail to maintain full compensation insurance, the City shall be entitled, at its election, either to take out compensation insurance to cover any compensation which the City might be liable to pay under the provisions of said Act, as amended, by reason of any employee, other than an immediate employee of the City, being injured or killed while engaged in the execution of the work covered by the contract, and deduct and retain the premium for such compensation insurance from any sums due the Contractor under the contract, or declare the contract terminated as hereinafter provided in Section 9 (w).

The Contractor shall at all times, upon demand by the Director, furnish proof that compensation insurance is being maintained in force and effect in accordance with the provisions of said Act, as amended, and the foregoing conditions and requirements.

(l) Corporate Surety Bonds.—Before the execution of the contract the successful bidder shall file with the Department of Public Works two corporate surety bonds, each in an amount of not less than fifty percent of the amount of the contract as awarded, one

Section 2

bond being for the faithful performance of the contract, and the other bond being to guarantee the payment of wages for services engaged, and all bills contracted for materials, supplies and equipment, used in the performance of the contract.

The attention of the bidder is directed to the maintenance requirements in Section 9 (x).

(m) Public Liability and Property Damage Insurance.—Subject to specific waiver or amendment in the Special Provisions the Contractor shall take out and maintain during the life of the contract such Public Liability and Property Damage Insurance as shall protect him and any subcontractor performing work covered by this contract, from claims for damages for personal injury, including wrongful death, as well as from claims for property damages, which may arise because of the nature of the work or from operations under the contract, whether such operations be by himself or by sub-contractor or anyone directly or indirectly employed by either of them even though such damages be not caused by the negligence of the Contractor, or any sub-contractor, or anyone employed by either of them. The said Public Liability and Property Damage Insurance shall also directly protect the City and County of San Francisco and its officers and employees, as well as the Contractor and his sub-contractors, and all insurance policies issued hereunder shall so state. The amounts of such insurance shall be as follows:

Public Liability Insurance in an amount not less than \$50,000 for injuries, including wrongful death, to any one person, and, subject to the same limit for each person, in an amount not less than \$100,000, on account of one accident, and Property Damage Insurance in an amount not less than \$5,000.

Provided, however, that the Director may accept insurance covering a subcontractor in character and amounts less than the standard requirements set forth under the above paragraph where such standard requirements appear excessive because of the character or extent of the work to be performed by such subcontractor.

The following special hazards shall be covered during the life of the contract by rider or riders to the policy or policies above required, or by separate policies of insurance in amounts as follows:

- (1) *Public Liability Insurance to cover each automobile, truck, and other vehicle used in performance of the contract in an amount not less than \$10,000 on account of injury to or death of one person and not less than \$20,000 on account of injury or death of two or more persons.*
- (2) *Property Damage Liability Insurance to cover each automobile, truck, or other vehicle used in performance of the contract in an amount not less than \$5000 in any accident.*

Before the execution of the contract, the successful bidder shall furnish proof satisfactory to the Director of Public Works that he has taken out public liability and property damage insurance

policies, as required herein, and that each such policy bears an endorsement requiring the insurance carrier to notify the Director five days before the cancellation of such policy.

The Contractor shall file with the Department a list of the automobiles, trucks, and other vehicles he proposes to use in the performance of the work under the contract, and shall file amendments as necessary during the life of the contract. This list and amendments shall give particulars sufficient for identification of the vehicles, as covered by the insurance policies.

(n) Sub-Contracts.—The Contractor shall constantly give his personal attention to the faithful prosecution of the work; he shall keep the same under his personal control and shall not assign by power of attorney or otherwise, nor sublet the whole or any part thereof without the consent or authorization of the Director. No sub-contract shall relieve the Contractor of any of his liabilities or obligations under the contract. The Contractor shall not, either legally or equitably, assign any of the moneys payable under this contract or his claim thereto, unless with the like consent of the Director.

In his proposal, the bidder shall set forth, on the blank form provided for this purpose, the name of each sub-contractor who will perform any portion of the work under the contract, together with the location of the mill or shop of such subcontractor, and the amount to be paid to such subcontractor for the performance of said portion of the work. The original sub-bids from subcontractors to the bidder shall show the registration numbers of the subcontractors' State licenses and City Certificates required by subdivision (i) of this section, and shall accompany the proposal and be enclosed in a separate envelope suitably marked for identification. Upon determination of the low bidder, his sub-bids shall be opened and examined for verification of the sub-contractors' bids as set forth in the proposal. All other original sub-bids not required in determining the lowest reliable and responsible bidder, will be returned unopened when the contract has been awarded.

The Contractor shall not, without the consent of the Director of Public Works, substitute any other person as a sub-contractor in the place of those mentioned in the proposal, nor shall any sub-contractor assign or transfer his sub-contract or permit the same to be performed by any other contractor.

If the Contractor fails to specify a sub-contractor for any portion of the work to be performed under the contract, he shall be deemed to have agreed to perform such portion of the work without sub-contracting the same, and he shall not be permitted to sub-contract said portion of the work. Should the Contractor thereafter let out or sub-contract any portion of the work for which he has not named a sub-contractor, his so doing will be deemed a breach of the contract and the Director of Public Works shall have the right to declare the contract terminated, in accordance with the provisions of Section 9 (w) herein.

Section 3

(o) **Contractor's Legal Address.**—The address given in the bid or proposal is hereby designated as the legal address of the Contractor, but such address may be changed at any time by notice in writing, delivered to the Director.

The delivering to such legal address or the depositing in the postoffice in a postpaid wrapper, directed to the Contractor at the above address, of any drawing, notice, letter or other communication, shall be deemed to be a legal and sufficient service thereof upon the Contractor.

SECTION 3

AWARD AND EXECUTION OF CONTRACT

(a) **Award of Contract.** The Director may reject any and all bids. The award of contract if made, will be to the lowest reliable and responsible bidder whose proposal complies with all the requirements prescribed, and will be made not less than ten days after last date of publication of the notice inviting sealed bids, or more than twenty days after the receipt of bids, unless the time for letting the contract be extended by resolution of the Board of Supervisors on the recommendation of the Director.

(b) **Execution of Contract.**—Within ten days after the award of contract, the bidder to whom the contract has been awarded shall enter into the contract after compliance with the provisions of Section 2, subdivisions (k), (l) and (m) above. If the bidder fails or neglects so to enter into the contract, the certified check which accompanied his proposal shall be deposited with the Treasurer of the City for collection, and the amount of said check shall be retained by the City as liquidated damages for the failure of such bidder to enter into said contract, except as otherwise provided by Ordinance No. 9.0871.

SECTION 4

PROGRESSIVE PAYMENTS

(a) **Progress Estimates.**—In order to assist the Contractor to prosecute the work advantageously, the Engineer shall on or about the last day of each month, make an estimate of the value of the work done and materials incorporated into the work by the Contractor.

These estimates shall be of the value of the labor done and materials incorporated into the work since the Contractor commenced the performance of the contract. Such estimates need not be made by strict measurements, but they may be approximate only, and shall be based upon the whole amount of money that will become due according to the terms of the contract when the whole of the work shall have been completed.

In estimating progressive payments, the Engineer may use the unit prices bid by the Contractor in his proposal. In case the said unit prices do not, in the opinion of the Engineer, truly represent the actual relative costs of the different parts of the work, he may prepare a new schedule of unit prices to be used in estimating progressive payments. Unless otherwise modified in the special provisions, no allowance will be made in these estimates for materials or equipment delivered at or near the site of the work but not incorporated into the work.

(b) Progressive Payments.—Upon each such estimate being made, the City will, subject to the provisions of subdivision (c) next below, pay or cause to be paid to the Contractor in the manner provided by law, a progressive payment. Such payment will be in an amount equal to 75 per cent of the Engineer's estimate, or such other amount as may be specified in the Special Provisions, less previous payments made.

All estimates and payments made under the provisions of this section shall be subject to correction in any subsequent estimate and payment. Under no circumstances shall the making of a progressive payment be construed as an acceptance of any of the work under the contract.

(c) Payment May Be Withheld.—Payments may at any time be withheld if the work is not proceeding in accordance with the contract, or if, in the judgment of the Engineer, the Contractor is not complying with the requirements of the contract and specifications.

SECTION 5

EXTENSIONS OF TIME AND LIQUIDATED DAMAGES FOR DELAYS

(a) Application for Extension of Time Must Be in Writing. When, due to unavoidable delay, the Contractor shall require an extension of time within which to complete the work under the contract, he shall file a written application for such extension with the Department of Public Works not later than thirty days before the date of expiration of the time for completion specified in the contract, or immediately upon the occurrence of such delay. This application shall set forth the Contractor's estimate of the additional time required, together with a full recital of the causes of delay upon which the application is based.

(b) Extension of Time Due to Unavoidable Delay.—If, after an examination of the facts, the Director shall determine that such delay was or will be caused by the unavoidable interruption of work due to bad weather, by acts of God or of the public enemy, by acts of a Governmental agency, by fire, floods, epidemics, strikes, quarantine restrictions or freight embargoes, or by an addition to the work done

Section 5

or to be done, pursuant to Section 2, Subdivision (d) herein, and that such delay was or will be unavoidable by the exercise of human foresight and diligence in the management and conduct of the work, the Director shall have the right to and shall grant such extension of time for the completion of the work as he may consider necessary and in the best interest of the City.

In the interpretation of the paragraph next above, bad weather shall mean weather which is so inclement as to prevent the Contractor from proceeding with his then controlling operations for at least 5 hours on any day with at least 60 per cent of his normal labor and equipment forces.

(c) Engineer May Suspend Work.—Should the Contractor fail to live up to these specifications or fail to obey orders given by the Engineer, which orders the Engineer has authority to give under these specifications, the City Engineer may suspend the work wholly or in part for such period or periods as he may deem necessary, and the Contractor waives any and all claims against the City or its officers for any loss sustained due to such suspension.

If the work is unavoidably suspended by the Engineer for reasons other than the above, and for causes beyond the Contractor's control, the Contractor will be given an extension of time equal to the period of such suspension.

If such suspension exceeds in time a period of thirty (30) consecutive calendar days, and is a complete suspension of all parts of the work, the Contractor will be compensated for any actual increase in cost of labor and materials to him which, in the opinion of the Director of Public Works, is caused by such suspension. The Contractor waives hereby all claims against the City and its officers for any loss sustained by him on all periods of suspension of the work of less than thirty (30) consecutive calendar days.

(d) Extension of Time for Delay Due to Lack of Right of Way.—An extension of time for the completion of the work will be granted for a period equal to the period of any delays caused by any failure of the City in obtaining title to any lands or rights of way necessary for the prosecution of the work.

Should the failure to obtain such title delay the work for a period exceeding thirty (30) consecutive calendar days and result in a complete suspension of all parts of the work, the Contractor will be compensated for any actual increase in cost of labor and materials to him which, in the opinion of the Director of Public Works, is caused by such delay. The Contractor waives hereby all claims against the City and its officers for any loss sustained by him on such delays of less than thirty (30) consecutive calendar days.

(e) Liquidated Damages for Delays.—It is hereby understood and agreed by the parties to the contract that in case the work included under the contract is not completed within the time specified, or within the time as extended in accordance with these specifications, damage will be sustained by the City, and that it will

be impracticable and extremely difficult to fix the exact damage, and it is, therefore, agreed that the Contractor will pay to the City as liquidated damages, and not by way of penalty, for each and every day required to complete the work beyond the time specified, or as extended in accordance with these specifications, the sum of twenty-five dollars (\$25), or such other sum as may be specified in the Special Provisions. The amount of such liquidated damages may be deducted and retained out of any moneys that may be due or become due to the Contractor under the contract.

SECTION 6

INTERPRETATION OF SPECIFICATIONS

(a) **Engineer to Decide Meaning.**—The specifications, plans and all supplementary documents are intended to be self-explanatory and cooperative, and to describe and provide for a complete work. Should any discrepancy, error or omission appear, or any misunderstanding arise as to the import of anything in the specifications, plans or supplementary documents, the matter shall be referred to the Engineer, who shall decide the true meaning and intent of the specifications, plans, or other documents. Such decision by the Engineer shall be final and conclusive.

Titles, headings, running headlines, marginal notes and indexes, when used, are merely for convenience and shall not be deemed to be any part of the contract for any purpose whatever. The misplacement, addition or omission of any word, letter, figure or punctuation mark shall in no way vitiate or change the true spirit, intent or meaning of the specifications.

Whenever, in the specifications, the words “as directed,” “as required,” “as permitted,” or words of like effect are used, it shall be understood that the direction, requirements or permission of the Director is intended. Similarly, the words “approved,” “acceptable,” “satisfactory,” “necessary,” or words of like import shall mean “approved by,” “acceptable to,” “satisfactory to,” or “necessary in the judgment of” the Director.

The reprinting or repetition in the specifications of certain clauses from any other specification or law or document, to which reference is made herein, shall in no way limit the scope of such reference or the applicability of any such specification, law or document, in its entirety. Such repetition is made only for convenience of reference, and is without significance as to the relative importance of the parts of any such specification, law or document.

No reference in the Special Provisions to any clause, subdivision, or section herein, shall be construed as limiting, or voiding any other applicable clause, subdivision or section herein.

Where work is not dimensioned on plans, it shall be executed according to the scale, but figured dimensions shall govern in all cases, although they may differ from the scale dimensions.

Section 7

(b) **Trade Names.**—Whenever any article or any class of materials is specified by a trade name or by the name of any particular patentee, manufacturer or dealer, it shall be and is mutually understood to mean and specify the article or class of materials described, or any other equal thereto in quality, finish and durability, and equally as serviceable for the purpose for which it is intended, subject to the approval and acceptance of the Director.

(c) **Reasonably Implied Parts of the Work Shall Be Done Though Absent From Specifications.**—Any part of the work which is not mentioned in the specifications, but is shown on the plans, or any part not shown on the plans but described in the specifications, or any part not shown on the plans nor described in the specifications, but which is reasonably implied by either or is necessary or usual in the performance of such work, shall be performed, as incidental work, without extra cost to the City, by the Contractor as if fully described in the specifications and shown on the plans, and the expense thereof shall be included in the price bid, in accordance with the provisions of Section 2 (g), herein.

(d) **Conflict Between Parts of Specifications.**—If there is any conflict between the requirements of these Standard Specifications, of the Special Provisions, and of the Plans, then the Special Provisions shall govern over both these Standard Specifications and the Plans, and the Plans shall govern over these Standard Specifications; provided that nothing herein shall limit or revoke the authority of the Engineer as set forth above in Subdivision (a) of this Section.

SECTION 7

LEGAL RELATIONS AND RESPONSIBILITY

(a) **Laws and Regulations.**—The Contractor shall keep himself fully informed of the Charter, Ordinances and regulations of the City, and of all Federal and State laws in any manner affecting the performance of the work or those engaged therein, and of all orders and decrees of Governmental bodies or officials having any authority or jurisdiction over the same. He shall himself observe and comply with and shall cause all his agents, employees and sub-contractors to observe and comply with said Charter and all such ordinances, regulations, laws, orders and decrees. The Contractor shall save harmless and indemnify the City and all its officers and employees against any claim or liability arising from or based on the violation of said Charter or any such ordinance, regulation, law, order or decree, whether by himself, his agents, employees or his sub-contractors.

(b) **Responsibility of Contractor.**—The Contractor shall take and assume all responsibility for the work. The Contractor shall bear all losses and damages directly or indirectly resulting to him, to the City, or to others on account of the performance or character of the work, unforeseen difficulties, accidents or any other causes whatsoever.

The Contractor shall assume the defense of and indemnify and save harmless the City and County of San Francisco, the Director of Public Works, and their officers and employees, from all claims, loss, damage, injury and liability of every kind, nature and description, directly or indirectly arising from the performance of the contract or work, regardless of responsibility for negligence; and from any and all claims, loss, damage, injury and liability, howsoever the same may be caused, resulting directly or indirectly from the nature of the work covered by the contract, regardless of responsibility for negligence.

(c) Patents.—All fees or claims for any patented invention, article or arrangement that may be used upon or in any manner connected with the doing of the herein proposed work or any part thereof shall be included in the price bid for doing the work herein proposed, and the Contractor and his sureties shall protect and hold any and all departments of the City, together with all its officers and employees, harmless against any and all demands made for such fees or claims and against any and all suits and claims brought or made by the holder of any invention, patent, copyright or trademark, or growing out of any alleged infringement of any invention, patent, copyright or trademark, and before the final payment is made on account of the contract, the Contractor shall furnish acceptable proof to the Director of a proper release from all such fees or claims.

(d) Use of Completed Parts of the Work Before Acceptance.—Whenever, in the opinion of the Engineer, the work or any part thereof is in a condition suitable for use, and the best interest of the City requires such use, the City may take possession of, connect to, open for public use, or use the work or such part thereof.

Prior to the date of acceptance of the work by the Director, all necessary repairs or renewals in the work or part thereof so used, not due to ordinary wear and tear, but due to defective materials or workmanship or to the operations of the Contractor, shall be made at the expense of the Contractor.

The use by the City of the work or part thereof as contemplated in this subdivision shall in no case be construed as constituting acceptance of the work or any part thereof. Such use shall neither relieve the Contractor of any of his responsibilities under the contract, nor act as a waiver by the City of any of the conditions thereof.

(e) No Waiver of Legal Rights.—The City shall not be precluded or stopped by any measurement, estimate or payment, or by acceptance of and payment for the work, from showing the true amount and character of the work performed, or from recovering from the Contractor and his sureties such damages as the City may sustain by reason of the Contractor's failure to observe all the terms of the contract.

Section 8

Neither acceptance of, nor payment for, the work, or any part of the work, nor any extension of time, nor any possession taken by the City, shall operate as a waiver of any portion of the contract, nor shall a waiver of any breach of the contract be held to be a waiver of any other or subsequent breach.

SECTION 8

CONTROL OF THE WORK

(a) **Work to Be Done to the Satisfaction of the Director.**—The Contractor shall do all the work and furnish all the labor, material, tools and appliances necessary or proper for performing and completing the work in the manner and within the time specified; the work shall be done in an orderly and workmanlike manner and under the direction and to the satisfaction of the Director, and the materials shall be in accordance with the specifications and to the satisfaction of the Director. The work shall be under the general supervision of the City Engineer acting as the representative of the Director.

These specifications contemplate the use of first-class materials throughout the work, and it is understood that any material for which no particular specification is given shall be the best of its class or kind.

(b) **Access to the Work.**—During the performance of the work under the contract, the Director, the Engineer, and all agents and employees of the City acting within the scope of the duties entrusted to them may at any time, and for any purpose, enter upon the work, or the shops where such work may be in preparation, and the Contractor shall provide proper and safe facilities therefor.

Other Contractors performing work for the City may also, for all purposes which may be required by their respective contracts, enter upon the work.

(c) **Inspection.**—All the work and materials and the manufacture and preparation of such materials from the beginning of the construction until the final completion and acceptance of the herein proposed work, shall be subject to the inspection and rejection of the Engineer at such times as may suit his convenience.

The Engineer may assign such assistants as he may deem necessary to inspect the materials to be furnished and the work to be done under the contract, and to see that the same strictly correspond with the specifications. The Contractor shall supply such information and assistance as may be required to make a complete and detailed inspection.

No Inspector will be furnished where, in the opinion of the Engineer, the number of men employed is too small to make proper progress.

The Contractor shall make application for an Inspector at least twenty-four (24) hours before his services are required.

Any work done during the absence of the Inspector shall be subject to rejection.

It is hereby understood and agreed that inspection of the work shall in no way relieve the Contractor of any of his obligations to fulfill the contract in accordance with the specifications, and defective work and materials may be rejected prior to the date of acceptance of the work notwithstanding that such defective work and materials may have been previously tested and inspected, or estimated for progress payments.

(d) Intimidation.—Engineers, inspectors and all other employees of the City shall be free at all times to perform their duties, and any intimidation or attempted intimidation of any employee of the City in the performance of his duty, by the use of intemperate, indecent, profane or threatening language, or otherwise, by the Contractor, his superintendent, foremen, or other employees, shall be a good and sufficient cause for the termination of the contract by the City in accordance with the provisions of Section 9 (w) herein.

(e) Samples and Test Specimens. Test specimens or samples of all materials, appliances and fittings to be used or offered for use in connection with the work shall be prepared and furnished to the City Engineer at the Contractor's expense, and in such quantities and sizes as may be required for proper examination and tests, with information as to their sources, and with all carriage charges prepaid.

Additional specimens and samples shall be furnished during the progress of the work, if required.

All samples and test specimens shall be submitted in ample time to enable the Engineer to make any tests or examinations necessary, and the Contractor will be held responsible for any loss of time due to his neglect or failure to deliver the required samples to the Engineer. Laboratory tests and examinations will be made by the Engineer without expense to the Contractor.

(f) Tests.—All tests of completed work required by the specifications, by City Ordinances or by law, shall be made under the direction of the Engineer, by and at the expense of the Contractor, who shall repair, at his own expense, all damage resulting therefrom.

Whenever required by the Engineer, the Contractor shall furnish all tools, labor and materials necessary to make an examination of any work under these specifications that may be completed or in progress. Should such work be found defective, the cost of making such examinations and of reconstruction shall be defrayed by the Contractor. Should the work be found to be satisfactory, the examination will be paid for by the City, under force account in accordance with the provisions of Section 10 (c) herein.

(g) Defective Work and Materials.—Any unfaithful or defective work or materials which, in the opinion of the Engineer, do not conform to the specifications, or are not equal to the samples submitted

Section 9

to and approved by him, shall be rejected and any such defective work shall be immediately replaced, repaired, or otherwise corrected when so ordered by the Engineer.

The Contractor shall at once remove from the work and its vicinity all rejected material of whatever kind, and upon his failure to do so within forty-eight hours after notice from the Engineer, such material may be removed by the Department of Public Works, and the cost of such removal shall be deducted from any money due or that shall become due to the Contractor on account of the contract.

All payments under the contract may be withheld until such defective work has been remedied, and such defective materials have been removed and replaced, as provided above.

(h) Spirituous Liquors.—The Contractor shall neither permit, nor suffer the introduction or use of spirituous liquors upon or about the work, or upon any ground occupied by him in the prosecution of the work.

(i) Proofs of Compliance With Contract Provisions.—In order that the Engineer may determine whether the Contractor has complied, or is complying with requirements of the contract which are not readily enforceable by inspection and tests of the work and materials, the Contractor shall upon request submit properly authenticated documents or other satisfactory proof of his compliance with such requirements.

SECTION 9

PROSECUTION AND PROGRESS OF THE WORK

(a) Commencement and Prosecution of the Work.—After the signing of the contract and the issuance by the Controller of the certificate required by Section 86 of the Charter, the Director will notify the Contractor to proceed with the work. The Contractor shall, within ten days after such notification, commence the work to be done under the contract, and shall prosecute it diligently thereafter at a rate sufficient to enable him to complete the work within the time specified in the Special Provisions.

(b) Substitutions.—The Contractor shall, within thirty days after notification by the Director to proceed with the work, submit for approval a complete list of all materials, articles or equipment which he proposes to substitute in place, and as the equal, of materials, articles or equipment which are specified by trade names or by the names of any particular patentee, manufacturer or dealer. Failure to submit such list within that time shall be deemed adequate and reasonable grounds for refusal by the Director to consider any subsequent proposed substitutions. Any items omitted from a duly submitted list may likewise be barred from subsequent consideration.

Complete details of each proposed substitute, including working drawings, catalogs, and test and other necessary data, shall be fur-

nished in time to permit investigation and approval without delay to the work. No approval shall be valid without the signature of the Engineer.

(c) Progress Schedule. Prior to starting the work, the Contractor shall submit to the Engineer a progress schedule showing his proposed sequence of operations in the performance of the work, and the estimated dates of starting and finishing the various major parts of the work. The schedule shall conform to the specified time for completion of the work, and shall be subject to the approval of, and modification by the Director.

When in the judgment of the Engineer, it is necessary to accelerate any part of the work ahead of the schedule, the Contractor shall, when so directed, concentrate his efforts on such part of the work.

(d) Cost Data and Contractor's Detailed Estimate.—During the performance of the contract, the Contractor, when requested, shall give the Engineer full and correct information as to the number of men employed in connection with each subdivision of the work, the classification and rate of pay of each man, the cost of each class of materials, tools, and appliances used in the work, and the amount of each class of materials used in each subdivision of the work. The Contractor shall, upon request, give the Engineer access to all payrolls, vouchers, invoices, etc., pertaining to the work for the purpose of ascertaining definitely the cost of any item of the work.

(e) Contractor to Check Plans and the Work of Other Contractors.—If the Contractor finds any figures, or measurements, or plans which appear to be in error, he shall immediately notify the City Engineer in writing. He will be required to examine the work of other contractors which in any way affects his work and verify the dimensions thereof, and should it appear that there is any error or discrepancy in either the plans or in the work or plans of other contractors, which will prevent the Contractor from constructing his work in a proper manner, he shall at once notify the Engineer in writing of such error or discrepancy so that the matter may be adjusted; and the Contractor will be held responsible for any damage or loss in the work due to his failure to fulfill these requirements.

(f) Cooperation.—The Contractor shall cooperate with all other contractors who may be engaged on related or adjacent work for the City, and he shall so conduct his operations as not to interfere with such work of other contractors or workmen employed by the City, nor to injure or damage such work.

Any differences or conflicts which may arise between the Contractor and other contractors or the workmen of the City in regard to such work, shall be adjusted as determined by the Engineer. The Contractor shall suspend any part or all of the work herein specified, or shall carry on the same in such a manner as may be prescribed

Section 9

by the Engineer, when the Engineer considers such suspension or prosecution of the work necessary in order to facilitate such work of other contractors or workmen, and no damage or claim by the Contractor will be allowed therefor other than such extension of the time specified in the contract for the completion of the work, as may be granted in accordance with the provisions of Section 5 herein.

The Contractor shall be held liable for any damage or delay to other contractors which may be caused by unnecessary delay or carelessness on his part.

The Contractor shall not hinder or interfere with any water, gas, telephone, electric light or power companies, or individuals having underground structures, in protecting their pipes or in removing or otherwise protecting and relaying their lines, conduits, or mains or service pipes, railroads, or any of their appurtenances.

No manhole, vault or other utility appurtenance shall be entered without the permission of the utility company or authority concerned.

(g) Engineer May Furnish Additional Drawings.—During the progress of the work, such additional detail drawings as the Engineer may consider necessary will be furnished to the Contractor and shall be part of the specifications. It is the understanding that all such additional drawings will conform in their general intent with the contract documents.

(h) Contractor to Furnish Drawings.—The Contractor shall furnish and submit to the Engineer for approval all necessary shop or working drawings. The approval of such drawings by the Engineer shall apply to general design only, and shall in no way relieve the Contractor from responsibility for errors, or omissions contained therein, nor from furnishing all labor and materials necessary in accordance with the specifications for the proper execution of the work.

Two prints of each such drawing shall be submitted in sufficient time to prevent delays to the work. One print of each drawing will be returned to the Contractor marked "To be corrected as shown," or "Approved." Prints of corrected drawings shall be resubmitted until approved. At least four prints of each drawing so approved shall be submitted for final approval and signature by the City Engineer.

Each drawing submitted shall be of one of the following sizes: 28-1/2" x 18-1/2" with 3/4" border, making a 30" x 20" drawing. 21" x 15" with 1/2" border, making a 22" x 16" drawing.

The above drawings shall have a 2" binding edge, measuring to the left of the border line on the short side of the sheet.

14-3/4" x 10" with 1/2" border on three sides and 3/4" border on one 10" side, making a 16" x 11" drawing.

7-3/4" x 10-1/2" with 1-4" border on three sides and 1-2" border on one 10-1/2" side, making an 8-1/2" x 11" drawing.

(i) Contractor to Maintain Office in San Francisco.—The Contractor shall maintain in the City and County of San Francisco during the continuance of his contract, an office equipped with telephone instruments connected with local and long distance telephone lines and shall have in said office at all times between 8:30 A.M. and 5 P.M. (Sundays and legal holidays excepted) a representative authorized to receive drawings, notices, letters or other communications from the Director, and the mailing to the Contractor at his office, or the delivery to him or to his authorized representative at any time or place, of any drawing, notice, letter, or other communication shall be deemed a legal and sufficient service upon the Contractor. Not later than ten days after he signs the Contract, the Contractor shall notify the Director of the address of this office.

(j) Contractor to provide Field Office for the Engineer.—At his own expense, the Contractor shall provide and maintain during the life of the contract a field office, and appurtenances for the free use of the Engineer and his representatives, convenient to the site of the work and equipped with a telephone, not of the coin service type, connected with the local and long distance telephone lines and maintained at the Contractor's expense. The office shall be of substantial weatherproof construction with a floor area of not less than one hundred square feet, and shall be equipped with suitable lockers for survey instruments and apparel, a drafting table not less than three feet by six feet, three chairs, suitable racks or drawers for storage of drawings, washstand, a stove or other heating device, adequate window area, and artificial illumination when work is conducted during the hours of darkness. Office or drafting equipment furnished by the City shall be transported to and from the field office at the beginning and end of the work, by the Contractor, without additional payment. All doors of lockers and office shall have cylinder type locks. The Contractor shall provide for the daily cleaning of the office and for an adequate supply of towels, soap, water and fuel.

Necessary survey stakes furnished by the City shall be hauled to the work and delivered at the field office by the Contractor, without additional payment.

(k) Sanitary Conveniences.—Necessary sanitary conveniences shall be constructed by the Contractor where needed, for the use of persons engaged on the work, and their use shall be strictly enforced; such conveniences shall be properly secluded from public observation; they shall be located, constructed and maintained subject to the approval of the Engineer, and the collection therein shall be removed at such times and to such places as he shall direct. The Contractor shall obey and enforce such sanitary regulations as may be prescribed by the Department of Public Health of the City.

(l) Contractor's Superintendent, Foremen and Workmen.—The Contractor shall at all times during his absence be represented on

Section 9

the work by a superintendent, foreman or foremen whom he has authorized and who is or are competent to receive and carry out any instructions that may be given to him or them by the Engineer or his representatives, and the Contractor will be held liable for the faithful observance of any instruction which may be delivered to him or to his authorized representative or representatives on the work. Only competent and skillful men shall be employed on the work, and whenever the Engineer shall notify the Contractor in writing that any employee on the work is, in the opinion of the Engineer, incompetent, unfaithful, disorderly or refuses to carry out the provisions of the contract or uses threatening or abusive language to any official or other person on the work representing the City, such employee shall be immediately discharged from the work and shall not be employed again on it except with the consent of the Engineer.

(m) Night and Sunday Work.—If Saturday, Sunday, Holiday, or overtime work is to be performed, the City Engineer's Office shall be notified at least 24 hours in advance.

(n) Illumination of Work. When any work is performed at night or in tunnel or in any other place where daylight is shut off or obscured, the Contractor shall at his own expense provide artificial illumination sufficient for the proper conduct and thorough inspection of the work.

(o) Use of Streets.—The Contractor shall not unnecessarily, in the judgment of the Engineer, obstruct or interfere with public travel over any public street or way, nor shall he store or place thereon any materials or supplies without first obtaining permission from the Engineer.

(p) Barricades, Warning Signs, Traffic.—The Contractor shall furnish, install, and maintain all necessary signs, lights, stairs, railings, barricades, bridges, and other safety devices, and shall take all other necessary precautions to prevent damage to life or property.

If the safe and proper conduct of the work requires the closing to public travel of any public street or way, or any part thereof, with consequent interruption or diversion of traffic, or if the work is adjacent to such street or way, the Contractor shall furnish, erect, and maintain throughout the progress of the work such warning, detour and other signs, barricades, fences, railings, underpasses, bridges, or other temporary structures as may be necessary for the safe and convenient passage of traffic through, past, around, over or under the work. The approval of the Engineer as to type, size and lettering of signs shall be obtained before erection. During the hours of darkness, sufficient red lights shall be maintained in good order on or at all such temporary structures and at a suitable distance therefrom to warn approaching traffic, and if necessary such signs and structures shall be artificially illuminated to insure adequate visibility.

The Contractor shall maintain full access to houses, private garages and other property by carefully constructed, compact and

unyielding plank roadways kept in good repair, or by other equally satisfactory means. Plank roadways shall be at least 8 feet wide.

When traffic is obliged or permitted to pass through grading or excavation operations, plank roadways shall be provided, or a smooth and firm road shall be maintained and oiled or sprinkled with water when necessary to prevent dust nuisance.

In order to avoid danger and delay to the public, the Contractor shall, when ordered by the Engineer, provide competent flagmen whose sole duty shall be to direct and control the movement of traffic through or past hazards incident to the work.

Bridges for pedestrians, and bridges for vehicular traffic of a width sufficient to accommodate the required number of traffic lanes, shall be installed where necessary across excavations or other work on public streets, at street crossings, and at entrances to residence, commercial, or industrial property, access to which shall not be unduly interrupted. Bridges shall be of substantial construction and adequate for the usual traffic to the property served. Floor planking shall have bevelled ends to permit smooth passage of traffic, and guard and hand rails shall be provided for the protection of the public. Vehicular bridges shall be not less than twelve feet wide.

The cost of all work contemplated above in this subdivision shall be included by the Contractor in the lump sum or unit prices bid, in conformity with Section 2 (g) herein, and no additional compensation will be allowed therefor.

(q) Watchmen.—The Contractor shall, where necessary, at his own expense, employ a watchman or watchmen, physically capable of adequately patrolling the whole of the work, who shall be at the site of the work at all times, except during ordinary working hours, from the beginning to the date of acceptance of the work.

The Contractor shall be responsible for the safety of engineering instruments and equipment belonging to the City and stored in the field office. When a watchman is not so located as to protect such instruments, they shall be moved to a safe place each night by the Contractor and returned each morning.

(r) Damage to Work or Property.—The Contractor shall be responsible for the safekeeping of, and shall protect the work and materials from damage due to the nature of the work, the action of the elements, the carelessness of other contractors, or from any other cause whatsoever, until acceptance of the work. Should any such damage occur, he shall repair it at his own expense, and leave the work to the satisfaction of the Director in every particular. Neither the City nor any of its officers, employees or agents assumes any responsibility for collecting indemnity from the person or persons causing damage to the work of the Contractor.

Any damage, arising from or in consequence of the execution of the contract, to tracks, pavements, curbs, sidewalks, walls, stairs, sewerage and drainage structures, mains, pipes, valves, conduits, poles, wires, transformers, to adjoining work, or to any other improvement

Section 9

or property above or below the surface of the ground, whether private or public, shall be repaired at once by the Contractor at his own expense, or upon the occurrence of such damage the Contractor shall obtain from the owner of the damaged property a release from his liability for such damage. If, in the opinion of the Engineer, the best interest of the City requires such repair to be made prior to the execution of any part of the work included in the contract, the Engineer will so notify the Contractor who shall delay or discontinue the performance of that part of the work until the necessary repair has been made. Such delay shall not be considered unavoidable, and no extension of time for completion of the contract will be granted therefor. When ordered by the Engineer to make any such repair the Contractor shall start work thereon within forty-eight hours and shall prosecute the same with diligence to completion. Upon failure of the Contractor so to comply with such order, or upon his failure to make immediate emergency repairs which are necessary in the best interest of the City or of the public, the Director shall have authority to cause such repair to be made and to deduct the cost thereof from any money due, or which may become due, to the Contractor.

(s) Line and Grade, City Monuments.—All the work shall be done in accordance with the lines, elevations and grades shown on the plans, the necessary survey stakes, marks or points for which will be set by the Engineer. The Contractor shall keep the Engineer informed in advance of his intended sequence of operations so that such survey points may be set, and measurements may be made, with the minimum of inconvenience and delay. No lines or grades will be furnished, when in the opinion of the Engineer the Contractor's forces are inadequate to make proper progress. The Contractor shall, when required, provide labor, tools and material to assist the Engineer temporarily in setting such stakes or points, and payment therefor shall be made as set forth under **Force Account in Section 10 (c)** herein. He shall have available at all times an accurate spirit level and straight edge suitable for checking or transferring elevations from such points to the work.

The Contractor shall so conduct his operations as to prevent, and shall caution his employees against, interference with or destruction of any such survey stakes, marks or points. The cost of resetting survey points lost or destroyed through the carelessness or negligence of the Contractor or his employees, and of resetting any point more than twice, shall be charged against the Contractor.

The Contractor shall bring to the attention of the Engineer all survey monuments, property marks and the like encountered on the work. Such monuments and marks shall be protected until referenced or relocated by the Engineer or other interested party. City survey monuments shall, under no circumstances, be disturbed without the permission of the Engineer. When required, the Contractor shall furnish necessary labor, tools, and concrete, and shall install cast iron frames and covers over existing City monuments, shall reset

existing frames to grade, and shall install or relocate such monuments, frames, and covers, as directed. No payment will be made for such installation or relocation, but the frames and covers will be furnished by the City.

(t) Miscellaneous Incidental Work Without Direct Payment.—

In accordance with the provisions of Section 2 Subdivision (g) herein, payment for all work incidental to the completion of the work contemplated under any lump sum or unit price bid is included in the lump sum or unit prices set forth in the contract, and no direct or additional payment shall be made for any such incidental work. For the guidance of the Contractor and to avoid unwarranted claims for extras, examples of such incidental work, for which no direct payment will be made except as otherwise expressly provided in the contract, are given below, and it is understood and agreed that, no complete enumeration of such work being possible due to the diversity thereof, the omission of any such work herefrom is inadvertent and no ground for any claim that such work is other than incidental and included in the price bid. Typical examples of such incidental work are the following: protection of the work against storm or ground water, or sewage, and the disposal thereof; grading, excavation, filling, backfilling, furnishing and installing lagging, sheet piling, shoring, bracing; disposal of surplus material, rubbish and debris from the work; provision of pipe stubs for future sewer and culvert connections; reconstruction or alteration, as necessitated by the work, or sewers, side sewers and culverts; maintenance of existing sewer service; repair or replacement of all improvements damaged during the work; removal of obsolete sewers, manholes and catchbasins, or the filling and sealing thereof; provision of safety structures and devices, barricades, temporary roads and bridges, signs, illumination of the work; all work pursuant to orders, resolutions, regulations, ordinances or laws of Governmental bodies having jurisdiction; relocation of street name signs, traffic signs and signals; traffic markers, and City owned lighting standards and trolley poles; resetting to finished grade all City owned manhole, lamphole, vent, hydrant, valve, junction box and pull box covers, in street or sidewalk areas; installation or relocation of City monuments, frames and covers; provision of concrete stringers under track rails, as shown on the plans; provision of necessary shop or detail drawings, samples and test specimens, and provision of equipment for and making of tests; provision of field office and appurtenances for the Engineer; and the provision of watchmen.

(u) Delivery of Salvaged Materials and Patterns to City Yard.—

All castings obtained during the work from abandoned sewers and appurtenances, and all granite curb, basalt blocks, paving brick and other materials from existing improvements and having salvage value, but which are not to be used in the work, shall be delivered to the Corporation Yard at Eleventh and Bryant Streets, or other designated point within the City at the Contractor's expense.

Section 9

All patterns made under the contract shall be the property of the City, and after use shall be delivered to the Corporation Yard, together with any patterns borrowed from the City.

Final acceptance of the work will not be recommended by the Engineer before submission to him by the Contractor of the receipts issued upon delivery of such castings, other materials, or patterns.

(v) Disposal of Rubbish, Final Cleanup.—The Contractor shall at all times conduct the work in an orderly and reasonably tidy manner, and shall at suitable intervals remove any accumulations of rubbish or refuse material.

Upon completion and before final acceptance of the work, the Contractor shall remove all rubbish, surplus or discarded material, falsework, forms, temporary structures, signs not a part of the work, and all his equipment and machinery, and shall leave the work in a clean and satisfactory condition.

(w) Termination of, or Default on Contract.—All conditions of the contract are considered material, and failure by the Contractor to comply with any of said conditions shall be deemed a breach of the contract. Upon the occurrence of such breach, the City shall have the right, whether any alternative right is provided or not, to declare the contract terminated, and the issuance by the Director of an order stating that the contract is terminated, and the service of a copy of said order upon the Contractor shall be deemed a complete termination of the contract. Upon the contract being so terminated, the City may retain all sums due under the contract and both the Contractor and his sureties shall be liable upon his bond for all losses, expenses and damages caused to the City by reason of his failure to complete the contract.

Time shall be of the essence of the contract.

If the Contractor fails to begin the work, as required by the contract, or if at any time he refuses, neglects, or fails, in the judgment of the Engineer, to have available on the work a sufficient amount of suitable materials, adequate equipment and a sufficient force of competent workmen, to insure completion of the work within the specified time, or if the Contractor fails to perform the work in good faith in an acceptable manner in accordance with the specifications, or if he refuses, neglects or fails for any reason whatsoever to observe any of the conditions and covenants of the contracts, or if he abandons the work, the Engineer may give the Contractor written notice, specifying the default and requiring its correction. Should the Contractor for three days after receipt of such notice of default, fail to proceed in accordance therewith to remedy such default, he shall, when so ordered in writing by the Director, discontinue or not begin the work or any designated part of the work, and any or all payments due or that may become due to the Contractor may be withheld by the City until the completion of all the work included in the contract.

After service on the Contractor of such order to desist from the work or part thereof, the Director may take possession of the work or

such designated part thereof, and may use any or all of the Contractor's plant, tools, equipment, materials or other property on the work, none of which shall be removed by the Contractor so long as they may be required for the work, and the Director may by contract or otherwise provide the superintendence, workmen, materials, appliances and equipment necessary for the completion of, and may complete the work, or such designated part thereof. The whole of the expense so incurred for the completion of the work or part thereof, together with all damages, liquidated or otherwise, sustained or to be sustained by the City shall be deducted from the fund or appropriation set aside for the purpose of the contract, and shall be charged to the Contractor as if paid to him. In case the amount of such expenses and damages shall exceed the sum which would have been payable under the contract if completed entirely by the Contractor, the amount of such excess shall be paid to the City by the Contractor, and both he and his sureties shall be liable to the City therefor; and in case the amount of such expenses and damages shall be less than the sum which would have been payable under the contract if completed entirely by the Contractor, he shall be entitled to the amount of the difference, subject to all the terms of the contract.

The Contractor shall continue to prosecute to completion all the work from which he has not, as above provided, been ordered to desist, and he shall cooperate with, and in nowise hinder or interfere with the forces employed by the City, or contract or otherwise, to do any designated part of the work as above specified.

Upon completion of all the work included under the contract, the Contractor shall be entitled to the return, of all of his materials which have not been used in the work, of his plant, tools, equipment and other property, provided, however, that he shall have no claim on account of usual and ordinary depreciation, loss, wear and tear.

(x) Maintenance.—The Contractor shall at his own expense make all necessary repairs and replacements to remedy in a satisfactory manner any and all defects due to faulty materials or workmanship in the work, or due to disturbance of or damage to City improvements by the Contractor's operations under the contract and contrary to the specifications, or due to other failure to comply with the specifications, when such defects occur:

- (a) *in any part of the work done under the contract, or in surface improvements of the City such as pavements, curbs, walks, tracks, poles, wires, walls, stairways, or other surface structures provided that such defect or defects be detected within one year following the date of acceptance of the work,*
- (b) *in subsurface improvements of the City, not included in the work under the contract, such as sewers, side sewers, culverts, other drainage structures, pipes, valves, conduits, conductors, or other subsurface structures, pro-*

Section 9

vided that such disturbance of or damage to said properties be detected within two years following the date of acceptance of the work.

Should the Contractor, after written notification by the Director, fail to remedy promptly any such defect occurring as set forth above under (a) or (b), or should the best interest of the City require an immediate remedy without the delay incident to such notification, the Director may cause such repairs, replacements or other remedy to be made, and the expense so incurred, limited in case (b) as provided below, shall be chargeable to, and shall be paid by the Contractor. Provided that such expense so incurred by the Contractor, or incurred by the City and paid by the Contractor, on account of disturbance of or damage to City improvements occurring as set forth under (b) next above, shall not exceed an amount equal to ten per cent of the contract cost, of all work to be done under the terms of the Specifications, or such other amount as may be set forth in the Special Provisions, and further provided that the liability of the surety on the faithful performance bond, on account of such disturbance of or damage to City improvements occurring as set forth under (b) next above, shall likewise not exceed ten per cent of the contract cost of all work to be done under the terms of the Specifications, or such other amount as may be set forth in the Special Provisions.

Nothing in this subdivision shall be construed as a waiver, or impairment of any of the City's rights under the contract, or of any other recourse provided by law.

(y) Public Safety and Convenience.—The Contractor shall conduct his operations with a proper regard for the safety and convenience of the public, and shall faithfully observe and comply with all requirements of these specifications conducive thereto.

He shall construct, provide, install, and maintain all required or necessary pavements, temporary pavements, conform pavements, bridges, ramps, planking, detour routes, barricades, and signs, so that vehicular and pedestrian traffic may proceed with reasonable convenience and without danger to person or property.

Should the Contractor, after written notification by the Director, fail to comply within 24 hours with any requirement of the paragraph next above, or should the best interest of the City require an immediate remedy without such notification, the Director may cause the necessary work to be done, and the cost thereof shall be chargeable to, and shall be paid by, the Contractor.

Nothing in this subdivision shall be construed as a waiver or impairment of any of the City's rights under the contract, or of any other recourse provided by law.

SECTION 10

MEASUREMENT AND PAYMENT

(a) **Measurement of Quantities.**—All work completed under the contract, other than work included under a lump sum bid price, shall be measured by the Engineer according to United States Standard Measures.

In estimating and allowing quantities all lengths and areas shall be based on horizontal measurements, unless otherwise specified. The planimeter may be used for measurement of areas in estimating quantities under the contract.

Pavement.—Pavement adjoining curb shall be measured from the face of curbs at a depth of six inches below the top of curb irrespective of the gutter depth, and when adjoining combined curb and gutter, the pavement shall be measured from adjoining edge of gutter. The area of curb adjoining sidewalk and areas occupied by curb inlets included in the price bid for catchbasins, shall not be included in measurements of area of sidewalk. Curb and combined curb and gutter shall be measured along the curb line within the limits thereof as constructed, excluding therefrom the length of curb line occupied by special curb inlet construction which is included in the price bid for catchbasins. No deduction from the area of pavement or sidewalk will be made for expansion joints, nor for any manhole cover, pole or other fixture having an area of less than nine square feet.

Sewers.—All sewers, side sewers, culverts, and drains shall be measured along the horizontal projection of their centerlines. Sewers, other than side sewers and culverts shall be measured from center to center of manholes, or where sewer does not end in a manhole, measurement shall be to the end of the sewer as constructed. The lengths of taper, junction, or other special structures, for which payment is provided at unit or lump sum prices, shall not be included in sewer measurements. Side sewers shall be measured from a point twelve inches behind the curb line, to the centerline of pipe sewers, or to the exterior surface of masonry or concrete sewers. Culverts shall be measured as specified under Section 159. No deduction will be made from the length of sewer on account of "Y" branches.

Grading.—Volumes of excavation and embankment shall be computed by the method of average end areas.

Truck Measurement.—Material specified to be measured by the cubic yard "loose measurement" or "truck measurement," shall be hauled in vehicles of suitable types and sizes, and of which the actual cubic contents can be readily and accurately determined. Unless all such vehicles are of uniform capacity, each shall bear a legible identification mark indicating its capacity as approved by the Engineer. Measurement of loads shall be made at loading or delivery point as specified in the Special Provisions. When required the Contractor

Section 10

shall strike off and level the load to facilitate inspection and measurement.

Concrete.—Measurement of concrete, unless otherwise provided, shall be made on the basis of the actual volume within the neat lines of the structure as shown on the plans. A deduction will be made, of one cubic foot per linear foot of piling, other than sheet piling, projecting into the concrete. No deduction will be made on account of the displacement of concrete by reinforcing steel, by structural steel shapes used in encasement work, by dowels or by conduits or ducts.

Piles.—Timber piles acceptably driven shall be measured from the bottom of pile to the point of cut-off, no allowance being made for the portion above cut-off, which shall remain the property of the Contractor. In measuring concrete piles, the length to be measured shall be the length of pile ordered by the Engineer.

Lumber and Timber. Lumber and timber shall be measured by the number of thousand feet, board measure, (M.B.M.) incorporated in the finished structure. Measurement will be on the basis of nominal sizes and actual lengths. No allowance will be made for waste.

Steel and Cast Iron.—Unless otherwise provided, steel, cast iron and other metals shall be measured by weight in pounds on shop scales in the presence of the Engineer.

If so provided in the Special Provisions, or directed by the City Engineer, weight shall be computed from dimensions shown on the plans or approved shop drawings without deduction for rivet or open bolt holes. No allowance shall be included for weld metal but an additional allowance for full weight of rivets before driving shall be included. The number of rivets so included shall be the exact number required for construction without excess to cover loss or waste. Weight of bolts actually left in place after construction shall be included, but no allowance shall be made for erection bolts.

(b) Changes and Extras.—In order to insure the proper completion of the improvement, structure, or other work contemplated in the contract, the Director, before the date of acceptance of the work, and in conformity with Section 2, Subdivision (d) herein, may in writing order alterations in the kind, amount, dimensions, or alignment of all or any part of the work, or may order the performance of additional work, and any such order shall be carried out by the Contractor in accordance with the intent of these specifications.

The Contractor shall, before putting any such order into effect, and in accordance with the provisions of Section 97 of the Charter, agree in writing with the City upon the adjustment to be made in the contract cost in consideration for the execution of such order.

When such order pertains to work of a class or classes for which unit prices are established in the contract, then such adjustment shall be made strictly in accordance with such unit price or prices.

When such order pertains to work of a class or classes for which no such unit prices are so established, then the agreed adjustment shall

either be based on unit prices determined upon fair and equitable grounds, or shall be a lump sum similarly determined, or such adjustment shall be made as provided below.

When such order pertains to work of a class or classes for which no such unit prices are so established, and when due to uncertain conditions to be encountered in the work, or for any other cause, no agreement can be reached upon appropriate unit prices or a lump sum adjustment, then the Engineer shall prepare an estimate of the labor, equipment and materials necessary for such work. This estimate shall show the number, amount, or quantities of the various classes of labor, equipment and material, together with the duration of employment of such labor and equipment. The total cost of performance of the work in accordance with said estimate, shall be computed as provided under Force Account in Subdivision (c) in this Section, and the agreed adjustment shall be made on the basis of this estimate and total cost.

No allowance will be made for anticipated profits in determining any adjustment to the contract cost due to any alteration in the amount of work performed under the contract.

Any agreement made pursuant to the provisions of this subdivision shall be a part of the contract and subject to all conditions thereof as they apply.

(c) Force Account.—The total cost of work done, or to be done, under force account by the Contractor's forces shall be the sum of the following component costs directly chargeable to such work:

(1) *The cost of labor* including foremen for the time actually engaged on such work.

(2) *The cost of materials* furnished by, and incorporated in such work, by the Contractor.

(3) *An amount equal to fifteen per cent* of the sum of the costs determined under the heads (1) and (2) above, which amount shall cover all claims for profit, tools, plant, depreciation, overhead and superintendence.

(4) *The cost of equipment*, which shall be as follows: for equipment owned by the Contractor or by a Sub-contractor the cost shall be a rental charge computed at the current prevailing rental rate for such equipment, with no addition whatever and for equipment rented with the approval of the Engineer, the cost shall be the actual rental price at a rate not to exceed the current prevailing rental rate, as shown by original vouchers, with the addition of five per cent thereof for carrying charges.

(5) *The cost of Workmen's Compensation Insurance.*

(6) *The cost incurred* under the U. S. Social Security Act.

(7) *The cost incurred* under the California Unemployment Reserves Commission Act.

Section 10

(8) *The cost incurred* for specified Public Liability and Property Damage Insurance, and other specified or approved insurance if any.

(9) *The cost incurred* under the California Retail Sales Act and the California Use Tax Act.

(10) *An amount equal to 1½ per cent* of the sum of the costs above established under the heads (1) to (9) inclusive, which amount shall be considered compensation for the cost of the bond for faithful performance and of the bond for materials and labor.

The total cost of work done, or to be done under force account by a sub-contractor shall be the sum of the component costs of such work determined as above set forth under the heads (1) to (10) inclusive with the addition of five per cent of said sum for the Contractor's profit, superintendence, overhead and all other expenses.

The total cost of work done, or to be done, under force account under the control of a subcontractor by forces other than his own employees, shall be the sum of the component costs of such work determined as above set forth under the heads (1) to (10) inclusive, with the addition of five per cent of said sum for the subcontractor's profit, supervision and all other expenses, and with the further addition of five per cent of said sum for the Contractor's profit, superintendence, overhead and all other expenses.

The City reserves the right to furnish such materials as it may deem expedient, and no allowance will be made for profit thereon.

All force account charges shall be recorded daily upon report sheets prepared by the Engineer, furnished to the Contractor, and signed by both parties, which daily reports shall thereafter be considered the true record of the force account work done. All bills for force account work shall be presented monthly at the time progress estimates are being made, and shall be accompanied by the original receipted bills for materials, and copies of payrolls bearing the Contractor's signed certificate of the truth and accuracy of such copies. The City may require the Contractor's signature to be acknowledged before a notary public.

(d) Acceptance and Payment.—Upon notification by the Contractor that the work is completed and ready for final inspection, the Engineer shall make such inspection. If the Engineer finds that the work covered by the contract has been fully and satisfactorily completed, he shall so notify the Director, and shall recommend the acceptance of the work, and final payment of the entire balance due to the Contractor.

The issuance by the Director in writing of an order accepting the work, and the receipt of a copy of such acceptance in writing shall be authority for the Controller of the City and County of San Francisco to complete any payments due the Contractor under the contract. Acceptance of the work may be withheld until the final estimate, determined as provided below, has been agreed to by the Contractor.

As soon as all necessary measurements and computations have been made, the Engineer will prepare the final estimate of the total

value of the work done in accordance with the terms of the contract. The amount of the final estimate shall be the contract cost adjusted as provided herein in Section 10, Subdivision (b), above.

The final payment shall be the amount of such final estimate, less the sum of all progress payments made as provided in Section 4, herein, and less the amount of any sum or sums deducted in accordance with the provisions of the contract, and shall be made in the manner provided by law.

PART II
MATERIALS

SECTION 20
PORTLAND CEMENT

(a) Types and General Requirements.—Portland cement shall comply with the requirements of the A.S.T.M. Standard Specifications for Portland Cement, Designation C150, and shall be of the type specified in the Special Provisions or Plans.

When the type is not so specified, Type I Portland Cement shall be used.

When High Early Strength Cement is specified, Type III Portland Cement shall be used.

When White Portland Cement, or White Cement, is specified, the cement used shall comply with the requirements for Type I Portland Cement, and its chemical composition shall be such as to yield a white product upon setting.

All cement shall be delivered at the work in good order in the original package, with the brand and the name of the manufacturer plainly marked thereon, unless shipped in bulk, in which case this information shall be contained in the shipping advices accompanying the shipment. Satisfactory means shall be provided to protect cement from dampness. A sack of cement shall contain 94 pounds of cement net, and this quantity shall be considered as one cubic foot in volumetric proportioning.

(b) Tests.—The Contractor shall, when requested, deliver to the Engineer not less than five samples of four pounds each from the manufacturer's bin for testing by the City. He shall also furnish the car number, and the manufacturer's certificate of analysis and test, with each car shipment from the City-tested bin. All cement shall be so handled and stored as to permit the identification of any shipment and its appropriate certificate.

The Engineer may test samples taken either at the mill or at the work, or both. Shipments covered by satisfactory manufacturer's certificates will, after sampling, be released by the Engineer for immediate use. When the cement is of a brand not previously tested, or of a brand of which previous samples have not complied with the specifications, the Engineer may require any shipment to be held in storage until the completion of 3-day and 7-day tests. To pass the 3-day test, a briquet, prepared as in the case of the 7-day test, shall attain a tensile strength of 175 pounds per square inch after one day in moist air and two days in water. For the 7-day test the minimum strength shall be 275 pounds.

All cement, the samples of which do not pass the specifications, and all cement which may have become damaged by exposure to

moisture, shall be immediately and permanently removed from the work.

If it is found, by subsequent tests, that the cement used in any part of the work was not in conformity with the specifications, then the Engineer may order the reconstruction of such part of the work. The Contractor shall perform such reconstruction at his own expense.

SECTION 21

HYDRATED LIME

Hydrated lime shall comply with the requirements of the A.S.T.M. Standard Specifications for Hydrated Lime for Structural Purposes, Designation C6.

Hydrated lime shall be used only when specified. It shall be used in such proportions as directed, but not to exceed 8 pounds of hydrated lime to each sack of cement used.

When used, the hydrated lime shall be added to the other materials in the mixer and thoroughly mixed therewith.

SECTION 22

DIATOMACEOUS EARTH

Diatomaceous earth shall be a fine natural siliceous product, 90 per cent of which shall pass a 200 mesh screen. It shall weigh not to exceed 11 pounds per cubic foot when screened loose through a 20-mesh screen into a $\frac{1}{4}$ cubic foot box and struck off.

When dried at a temperature of 105 degrees centigrade, the loss in weight shall not be more than 10 per cent.

SECTION 23

SAND OR FINE AGGREGATE

Fine aggregate shall consist of material of siliceous, granitic or igneous origin, and shall be hard and durable. It shall be free from oil and injurious amounts of clay, shale, mica or other objectionable materials.

When tested by the A.S.T.M. Standard Method of Decantation Test for Sand and Other Fine Aggregates, Designation D 136, fine aggregate shall lose not more than 3 per cent by weight.

When tested by the A.S.T.M. Standard Method of Test for Organic Impurities in Sands for Concrete, Designation C 40, fine aggregate shall not show a solution color darker than the standard color solution.

Sand or fine aggregate, when tested with standard sieves of square mesh wire construction, shall comply with the following grading requirements.

Section 24

Percentages by weight passing

3/8" sieve.....	100
No. 4 sieve.....	85-100
No. 8 sieve.....	75- 90
No. 16 sieve.....	55- 75
No. 30 sieve.....	30- 50
No. 50 sieve.....	12- 20
No. 100 sieve.....	0- 7

Fine aggregate for use with white cement shall be Olympia Sand, or equal.

SECTION 24

ROCK OR COARSE AGGREGATE

Coarse aggregate shall consist of clean, hard, durable, crushed rock or gravel, such as trap, limestone, granite, or altered sandstone. It shall contain not more than 10 per cent of inferior materials, or flat or elongated particles. Any delivery containing cracked or laminated rock or rock which can readily be broken after immersion in water for 1 hour, will be rejected. When shaken or washed in water, the volume of silt settling in 1 hour shall not exceed 3 per cent of the volume of the sample.

Coarse aggregate shall be classified in terms of the maximum size of material, and shall comply with the following grading requirements, when tested with standard sieves of square mesh wire construction:

Maximum size, inches	3	1 1/2	1
Percentages by weight passing			
3 " Sieve.....	95-100	.....	.....
1 1/2" Sieve.....	40- 55	100	.....
1 1/4" Sieve.....	.....	95-100	.....
1 " Sieve.....	.....	.....	100
3/4" Sieve.....	20 -35	40- 55	90-100
1/2" Sieve.....	.....	15- 40	.....
3/8" Sieve.....	.....	.....	15- 25
No. 4 Sieve.....	0- 10	0- 10	0- 10

Except in the case of 1" aggregate, coarse aggregate shall be furnished in at least two sizes, one of which shall all pass a 3/4" sieve and be retained on a 1/4" sieve. Material of each size shall be handled separately and combined with the other size or sizes when the aggregates are proportioned for each batch of concrete.

If the coarse aggregates are stock-piled, that portion of the coarse aggregates retained by a 3/4" sieve shall be segregated into two sizes, one of which shall pass a 1 1/2-inch sieve and be retained on a 3/4-inch sieve, while the other size shall consist of that portion of the coarse aggregates retained on a 1 1/2-inch sieve.

SECTION 25

WATER

Water shall be fresh and clean, free from oil, acid, alkali, or vegetable matter.

SECTION 26

LAMP BLACK

Lamp black shall be a product procured from oils and shall not contain more than 1 per cent of ash. It shall conform to the requirements of the Standard Specifications of the A.S.T.M. Designation D-209. The use of gas house black will not be permitted.

SECTION 27

MORTAR, GROUT

The different classes of mortar shall be as follows:

Class of Mortar	Uses	Sacks of Cement	Cubic Feet of Sand
A	Finish mortar for sidewalks, steps, etc., pipe joints, brick paving, etc.	1	1½
B	Brickwork, plaster for retaining walls, etc.	1	2
C	Brickwork or plaster exposed to sewage	1	1

Grout shall be composed of Class "C" mortar diluted with water to required consistency.

Class "A" mortar for sidewalks and steps shall be tinted by the addition to the mortar of ⅛ pound of lampblack to each sack of cement used.

Sand for mortar for use in pipe joints, brick paving or brick work need not pass the grading requirements of Section 23, provided it shall comply with the following grading requirements:

Percentage by Weight Passing

No. 10 Sieve	100
No. 50 Sieve, not over	85
No. 80 Sieve, not over	15

Mortar may be mixed in either a mixing machine or in a watertight box. In either method the materials shall be accurately measured. If a machine is used to mix the mortar, all the materials, including the coloring matter, and sufficient water shall be put in the mixer and allowed to mix at least 1 minute.

If the mortar is mixed by hand, the materials, including the coloring matter, shall be measured in a watertight box and turned at least 3 times with a hoe or shovel. Sufficient water shall then be added, and the mixing continued until the batch is uniform in color and consistency. All mortar must be used immediately after mixing, and retempered mortar shall not, in any case, be used.

SECTION 28

CONCRETE

(a) **General.**—Concrete shall be composed of Portland cement, sand or fine aggregate, coarse aggregate, and water, proportioned and mixed in compliance with the Specifications.

The different classes of concrete shall conform to the following limiting requirements and shall contain the quantity of cement indicated:

Class	Max. Gals. of Water per Sk. of Cement	Max. Size of Coarse Aggregate in Inches	Slump in Inches	Minimum Strength in Lbs. per Sq. Inch at 28 Days	Sks. of Cemen Cu. Yd. of Concrete
A	6.00	1½	4-6	3,500	7
B	6.75	1½	4-6	3,000	6
B-1	7.25	1½	4-6	2,500	5
C	6.75	1½	1-3	3,000	6
D	8.00	3	3 max.	2,000	4
E	7.00	3	2 max.	3,000	5
F	7.50	1½	2 max.	3,000	5
G	6.00	1	4 max.	3,000	8
H	7.50	1	4-6	3,000	6

Unless otherwise specified, the above classes of concrete shall be used in the following types of construction:

Class A.—Columns requiring high working stresses due to heavy loading.

Reinforced concrete in sea water or frequently wetted thereby.

Concrete deposited under water.

Concrete piles exposed to sea water.

Class B.—Reinforced concrete columns, girders, beams and slabs where reduced sections are required for clearance. Bridges.

Water tanks.

Reinforced concrete retaining walls.

Sewers and manholes.

Tunnel linings.

Concrete piles, except as above.

Class B-1.—Reinforced concrete buildings (except as above).

Floor slabs placed directly on the ground.

Machinery foundations.

Heavily reinforced footings.

Class C.—Concrete curbs.

Class D.—Mass concrete.

Plain concrete or lightly reinforced concrete footings.

Gravity retaining walls.

Curtain walls.

Class E.—Concrete pavement.

Class F.—Concrete sidewalk.

Class G.—Concrete handrails and posts, fence rails and unplastered balustrades.

Class H.—Same structures as Class B when reinforcement precludes use of $1\frac{1}{2}$ " aggregate.

The amount of water specified above is the total quantity included in the mix, and in measuring the water to be added, a deduction shall be made equivalent to the total moisture in the aggregates. The maximum amount of water specified above for each class of concrete shall not be exceeded, and no increase whatever will be allowed. However, the quantity of water shall be varied, below the maximum amount, as may be necessary to obtain proper workability in the concrete while maintaining the specified slump. Any necessary increase in the workability of the concrete shall be obtained by decreasing the quantity of aggregates, and in no case by increasing the amount of water above the maximum amount specified.

The amount of fine aggregate shall be just sufficient to produce a plastic and workable mix which can easily be tamped to a smooth surface of uniform texture. Over-sanded mixes will not be permitted.

Fine aggregate, coarse aggregate and bulk cement shall be separately measured by weighing in approved cumulative dial-scale-weighing devices. The correctness of all such weighing devices shall be certified by the Sealer of Weights and Measures of the City as provided by law, or more frequently when necessary to insure their accuracy while in use on the work.

When a sacked cement is used the batches of concrete shall contain a whole number of sacks, as no splitting of sacks of cement will be permitted. As the cement sacks are emptied they shall be neatly piled in bundles of 50 to facilitate counting by the inspector.

In order to improve the workability of concrete the addition to the mix of diatomaceous earth will be permitted. The amount of diatomaceous earth so added shall be subject to the approval of the Engineer, and shall in no case exceed 3 per cent by weight of the cement used. No decrease in the amount of cement shall be made on account of the use of diatomaceous earth, and no extra payment will be made for such use.

The slump of concrete shall be determined by the A.S.T.M. Method of Test for Consistency of Portland Cement Concrete, Designation D-138.

Neither the use of concrete later than 45 minutes after the introduction of any water to the batch, nor the use of concrete which has partially set will be permitted.

(b) Mixing Concrete.—Concrete shall be mixed in a mixer of approved type which shall have a rated capacity for a batch containing at least one full sack of cement.

The mixer drum shall have a speed of not less than 14 nor more than 18 revolutions per minute, and every batch of concrete shall remain in the mixer 60 seconds after all materials have been added

Section 28

before any portion of the batch is discharged from the drum. The drum shall not be charged while the mixer is discharging, and the entire contents of the drum shall be emptied before any materials are placed therein for the succeeding batch.

The total volume of all materials mixed per batch shall not exceed the rated capacity of the mixer, as established by the current Concrete Mixer Standards of the Associated General Contractors of America. The concrete mixer shall be equipped with a device that will exactly measure the amount of water specified, and also with a timing device, so constructed that it is put in operation when the skip is raised to its full height and is dumping, or in the case of a central mixing plant, when the concrete materials are introduced into the mixer. Such timing device shall ring a bell after the specified time of mixing has elapsed.

The Contractor shall furnish, and keep available at the mixer, a suitable measuring device for checking the amount of water that is being added to the mix.

During pavement construction the method of placing concrete shall be such as to prevent segregation of the concrete materials and avoid damage to the subgrade, and such as to cause a minimum of rehandling of the concrete. Each batch shall be conveyed over the subgrade by means of a boom and bucket, or other approved device, and shall be deposited within the area to be covered by that batch. The use of a chute will not be allowed in pavement construction.

Whenever a concrete mixer is not adequate or suitable for the work, it shall be removed from the work and a suitable mixer provided by the Contractor.

Pick-up and throw-over blades in the drum of the mixer which are worn down $\frac{3}{4}$ -inch or more in depth must be replaced by new blades.

(c) Central Mixing Plant.—When a wet central mixing plant is used, the concrete shall be continuously agitated in an approved mixer type truck during transit from the plant to the work, where it shall be delivered not later than 45 minutes after the addition of the water to any batch. Any batch showing segregation of materials upon delivery shall be rejected.

(d) Mixing at the Work.—When concrete is mixed at the place of use, and the aggregates and cement are proportioned and combined at a batching plant, then each batch shall be thoroughly pre-mixed in a mixer at the batching plant, with no added water, before transit to the place of use, for final mixing as provided in Subdivision (b) above.

When the cement is added and the concrete is mixed at the place of use, the weighed aggregate shall first be dumped into the skip, after which the cement shall be added from sacks. In no case shall the cement be emptied from the sacks onto the aggregate in the truck before dumping into the skip. The sacks of cement shall be handled with care to avoid wastage of cement, and the cement shall be so spread in the skip as to prevent loss when the skip is raised. Each sack shall be completely emptied by proper shaking. Before use the sacks of

cement shall be distributed along the work in piles, each pile containing the required number of sacks for one batch.

(e) Protecting and Curing Concrete.—All fresh concrete shall be adequately protected from the weather and sun, and from mechanical injury until thoroughly set and of sufficient strength to prevent damage, and shall be cured by the use of water, or an approved impervious membrane, or as otherwise specified herein or in the Special Provisions. When high early strength cement is used, the Engineer will reduce the required protection and curing periods as much as possible without detriment to the concrete.

No equipment or other injurious traffic shall be allowed on concrete pavement or base during the 10-day curing period required below, and public travel shall not be allowed on the concrete for 14 days after pouring.

Water Curing.—When water is used the concrete shall be kept wet, so as to prevent the appearance of dry patches, for a period of 10 days after pouring. This shall be accomplished by ponding, by the use of a sprinkler system, or by means of a 2-inch layer of sand or earth kept moist by sprinkling twice a day. Only clean, fresh water shall be used. After the curing period the earth or sand shall be completely removed, and the concrete surface shall be thoroughly cleaned.

Concrete pavement and base shall be kept covered with wet burlap until the concrete is hard enough to permit ponding or sprinkling or the use of the sand or earth covering.

Surfaces enclosed in timber forms shall be kept moist by sprinkling the forms and supports at least twice a day for ten days.

Impervious Membrane Curing.—When concrete, other than concrete pavement base, is cured by means of an impervious membrane, the curing shall be done by the use of an approved liquid which will form a practically colorless, impervious, non-slippery membrane when dry. The liquid shall have a temporary color sufficient to indicate the extent of its application. It shall form a hard film and shall thoroughly waterproof the concrete surface within 30 minutes.

When concrete pavement base is cured by means of an impervious membrane, the curing shall be done by the use of an approved liquid of the asphalt cut-back type, which will form a permanently dark colored, impervious, non-slippery membrane when dry. The liquid shall form a hard film and shall thoroughly waterproof the concrete surface within 30 minutes.

Curing liquids shall be applied under pressure with a spray nozzle at such a rate as to seal the surface uniformly and completely.

The seal shall be protected from injury for 10 days, and any breaks in the membrane during this period shall be immediately repaired by a fresh application of the liquid.

SECTION 29

CURB BAR

Armor for concrete curbs shall be hot-dip galvanized steel curb bar of the open anchorage type, and shall be furnished in ten foot lengths. The quality of the steel shall comply with the requirements of the A.S.T.M. Standard Specifications for Billet-Steel Concrete Reinforcement Bars, Designation A-15.

Curb bar shall have a rounded outer edge of approximately one inch radius, and shall have a maximum dimension transverse to the curb of not less than two inches.

SECTION 30

EMULSIFIED ASPHALT

(a) **General.**—Emulsified Asphalt shall be a quick-setting homogeneous emulsion of asphalt and alkaline water and shall not contain more than one per cent total of alkali, clay, fatty acids and other emulsifying or stabilizing agents, including petroleum acids. It shall remain homogeneous for not less than three months unless separation has been caused by contamination or freezing.

When required by the Engineer the Contractor shall furnish samples of the asphalt and emulsified asphalt in air-tight sealed glass containers. The samples of emulsion shall be kept at a temperature between 40° and 80° F. until tested.

(b) **Emulsion.**—When tested as hereinafter specified the emulsion shall conform to the following requirements:

Viscosity.—Saybolt Furol 60 cc. at 25° C.

(77° F.).....30 to 70 Secs.

Saponifiable Substances, including

petroleum acids.....Not more than 0.75%

Specific Gravity.—25°/25° C. (77°/77° F.).....Not less than 1.00

Residue at 163° C. (325° F.) 3 hrs. 50 grs.) or {.....55% to 60%

Residue from Distillation Test (ASTM)

Demulsibility.—35 ml. N/50 Ca Cl₂.....Not less than 75%

Settlement, 10 days.....Not more than 3

Sieve Test.....Not more than .05

Tests on the emulsified asphalt shall be made in accordance with A.S.T.M. Tentative Standards D 244-36T, except as follows:

Residue at 163° C.—A.S.T.M. Standards, Designation D 6-30, except that determination of residue shall be the average of three 50-gram samples, heated for 3 hours in a dish or beaker not less than three inches in diameter and of sufficient depth to prevent overflow.

Amount of Saponifiable Substances, including petroleum acids, soaps, fatty or resinous acids and sulphonated oils in accord-

ance with Test Method 37-E, as described on Page 753 of the Third Edition of "Asphalt and Allied Substances," by Abraham.

Settlement.—The time allowed for settlement shall be 10 days instead of 5 days.

(c) **Asphalt.**—The petroleum asphalt prior to emulsification shall conform to the following requirements:

Penetration at 25° C.—(77° F.).....Not less than 250

Solubility in carbon disulphide.....Not less than 99%

Ductility at 77° F......Not less than 125 cms.

Percentage 80 Penetration Asphalt.....Not less than 90%

Tests of asphalt and residue shall be made in accordance with A.S.T.M. Standard or Tentative Standards in effect at the time the test is made, except as follows:

Ductility.—When the ductility test is made on residue, the residue shall be screened through a No. 50 sieve while still hot and then kneaded until uniform and homogeneous.

Percentage 80 Penetration Asphalt.—A.S.T.M. Tentative Standards D244-28T.

SECTION 31

ASPHALTIC CEMENT

Asphaltic cement shall be prepared from a California crude asphaltic petroleum. Asphaltic cement shall be tested in accordance with the methods prescribed by the American Society for Testing Materials, except for solubility in carbon tetrachloride, and shall conform to the following requirements:

- (1) *Asphaltic cement* shall be homogeneous and free from water.
- (2) *Penetration*, unless otherwise specified, shall be between 70 and 80.
- (3) *Penetration at 77° F.* after heating for five consecutive hours at 325° F., not less than 60% of original penetration.
- (4) *Loss after heating* for five consecutive hours at 325° F., not more than 2%.
- (5) *Total bitumen* soluble in carbon disulphide, not less than 99.5%.
- (6) *Per cent of total* bitumen soluble in carbon tetrachloride, 98%

Section 32

(7) *Ductility at 77° F.*, not less than 30 centimeters

In the test for solubility in cold carbon tetrachloride 200 cubic centimeters of the solvent shall be poured on one gram of asphaltic cement, and the mixture allowed to stand for 18 hours at a temperature of 77° F. and then filtered while at this temperature. During this test the mixture shall be subject to nonactinic light only.

SECTION 32

STONE DUST

Stone dust may be Portland cement, fine powdered limestone, or other artificially or naturally powdered dust which will meet the following tests:

It shall be free from lumps, balls, or detrimental material. It shall all pass a 50 mesh sieve, and at least 80 per cent shall pass a 200 mesh sieve. Of the material passing the 200 mesh sieve, 75 per cent shall be impalpable powder as determined by the following elutriation test:

Five grams of mineral filler passing the 200 mesh sieve shall be placed in a flat bottom beaker, 11 centimeters high inside, with an inside diameter of between 8 and 8½ centimeters. The beaker shall then be filled with distilled water to a height of 9 centimeters, thoroughly agitated with a uniform continuous blast of air, allowed to settle for 15 seconds, and siphoned in 15 seconds at a uniform rate by means of a tube 9 millimeters inside diameter, equidistant from the sides and ending at a point 12 millimeters from the bottom of the beaker. The process of filling, agitating, settling, and siphoning shall be performed three times. The residue shall then be dried and weighed and the difference between the weight of the residue and the original weight shall be deemed the weight of the impalpable powder.

Stone dust shall readily incorporate into a bituminous mixture.

SECTION 33

EXPANSION JOINT FILLER

Expansion Joint Filler shall consist of premolded strips of a durable resilient compound composed of mineral or vegetable matter, or a stable mixture of these elements.

The filler shall comply with the requirements of the American Association of State Highway Officials' Specifications M-59-38 and subsequent revisions thereof, and shall be tested in accordance with that Association's Standard Method T-42-38 and subsequent revisions thereof.

SECTION 34**BITUMINOUS SEWER JOINT COMPOUND**

Bituminous sewer joint compound, for use with vitrified clay pipe as specified in Section 157 (c), shall have a bituminous base, shall melt and run freely at a temperature as low as 250 degrees F., shall adhere firmly to the surface of the pipe, and shall be steam refined.

Specific gravity at a temperature of 25 degrees Centigrade shall be not less than 1.40 nor more than 1.50.

The softening point, as determined by the Ring and Ball method, A.S.T.M. Serial Designation D 36, shall be not less than 90 nor more than 95 degrees C.

The penetration, as determined by A.S.T.M. standards, Serial Designation D 5, shall be not less than 10 nor more than 15. Adhesion at 25 degrees C. shall be not less than 80 pounds per square inch. Total bitumen shall not be less than 48% nor more than 52%. The total inert material shall be not less than 48% nor more than 52%.

The compound shall not deteriorate in water or sewage and, when immersed for a period of five days in a 1% solution of hydrochloric acid or a 5% solution of caustic potash, it shall show no chemical action.

The compound shall be so prepared that when at a temperature of 250 degrees F. and poured, it will adhere firmly to the surface of a dry pipe, or when heated to a temperature of 350 degrees F. and poured, it will adhere firmly to the surface of a wet pipe.

The compound shall be so flexible that when a joint has been poured and cooled, the pipe may be deflected 5 degrees from line or grade without causing the joint material to check, crack, or break away from the surface of the pipe.

SECTION 35**COMMON BRICK**

Common bricks shall be whole, sound, hard-burned clay, shall have straight edges, and must give a clear ringing sound when struck together. Common bricks shall comply with the requirements of the A.S.T.M. Standard Specifications for Building Brick, Designation C-62, Grade MW.

All common bricks shall have the following dimensions: depth $2\frac{1}{4}$ inches, width $3\frac{3}{4}$ inches, length 8 inches, with a permissible variation of $1/16$ -inch in depth, $1/8$ -inch in width, and $1/4$ -inch in length.

SECTION 36**VITRIFIED BRICK**

Vitrified bricks shall be uniform in size and quality. They shall be sound, smooth, true to shape, vitrified entirely through, free from

Section 37

cracks or defects, and shall comply with the requirements of the A.S.T.M. Standard Specifications for Clay Sewer Brick Designation C-32, Grade SA, and shall be in size not less than $2\frac{1}{4}" \times 3\frac{3}{4}" \times 8"$ nor more than $2\frac{1}{2}" \times 4" \times 8\frac{1}{2}"$.

SECTION 37 PAVING BRICK

Paving bricks shall be vertical fiber lug bricks, and shall comply with the requirements of the A.S.T.M. Standard Specifications for Paving Brick, Designation C7.

Paving bricks shall be $2\frac{1}{2}$ inches deep, 4 inches wide, and $8\frac{1}{2}$ inches long, and shall be uniform in size and shape and specially burned for paving purposes. They shall be thoroughly annealed, tough, durable and evenly burned. When broken, paving brick shall show a uniformly dense, stonelike body, free from lime, air pockets, cracks, and marked laminations.

The loss in the rattler test shall not be greater than 26 per cent.

SECTION 38 VITRIFIED CLAY PIPE

Vitrified clay pipes shall be of the best quality vitrified clay, salt-glazed, or unglazed, burned entirely through and smooth on their interior and exterior surfaces and free from warps, cracks, or other defects, and must give a metallic ring when struck with a hammer. They shall be of the ordinary hub and spigot type, shall be furnished in standard commercial lengths, shall be of uniform thickness, and shall not vary from true cylinders more than $\frac{1}{36}$ of their diameters.

The sizes of vitrified clay pipes shall be designated by their respective inside diameters.

The minimum thickness of the barrel of pipe shall be as follows:

6-inch pipe, $\frac{5}{8}$ inch	15-inch pipe, $1\frac{1}{4}$ inches
8-inch pipe, $\frac{3}{4}$ inch	18-inch pipe, $1\frac{1}{2}$ inches
10-inch pipe, $\frac{7}{8}$ inch	21-inch pipe, $1\frac{3}{4}$ inches
12-inch pipe, 1 inch	24-inch pipe, 2 inches

Vitrified clay pipe and fittings shall comply with the requirements of the A.S.T.M. Standard Specifications for Clay Sewer Pipe, Designation C-13, except that the pipe may be unglazed as indicated above.

SECTION 39 DRAIN TILE

Drain Tile shall comply with the requirements of the physical tests of the A.S.T.M. Standard Specifications for Drain Tile, Designation C-4, and shall be "Extra Quality" as specified therein.

The tile shall be made from shale, fire clay, or surface clay, and shall be well burned and free from checks extending into the body of the tile in such a manner as to decrease its strength appreciably.

The sizes of the drain tile shall be designated by their interior diameters, and shall have a length of 12 inches. They shall be circular in cross-section, approximately straight, and the ends so regular and smooth as readily to admit of making close joints by turning and pressing together adjoining tile.

The tile shall be substantially uniform throughout in structure, and shall give a clear ring when stood on end and while dry, tapped with a light hammer. All tile shall be reasonably smooth on the inside.

SECTION 40

CORRUGATED METAL PIPE

(a) **Base Metals.**—Corrugated metal pipe shall be fabricated from corrugated galvanized sheets, the base metal of which shall be made by the open hearth process.

The base metal shall conform to one of the following alternative chemical requirements:

CHEMICAL COMPOSITION BY LADLE ANALYSIS

CHEMICAL COMPOSITION BY LADLE ANALYSIS

Elements	(Position of base metals does not indicate preference)					Tolerance by check analysis of finished sheets
	First Alternative Pure Iron	Second Alternative Copper bearing Pure Iron	Third Alternative Copper Iron	Fourth Alternative Copper Molyb- denum Iron	Fifth Alternative Copper Steel	
Carbon						
Max. per cent. ....	....	....	....	....	....	....
Manganese						
Max. per cent. ....	....	....	....	....	....	....
Phosphorous						
Max. per cent. ....	.015	.015	.015	.015	....	....
Sulphur						
Max. per cent. ....	.040	.040	.040	.040	.050	.010
Silicon						
Max. per cent. ....	....	....	....	....	....	....
Copper						
Min. per cent. ....	....	.20	.20	.40	.20	.02
Molybdenum						
Min. per cent. ....	....	....	....	.05	....	....
Sum of first 5 elements						
Max. per cent. ....	....	.10	.25	.25	.70	.04
Sum of first 6 elements						
Max. per cent. ....	.10	....	....	....	....	.04

(b) **General Requirements.**—The sheet of metal before galvanizing shall be smooth and free from blisters, seams, and pits.

The galvanizing shall consist of not less than 2 ounces of prime spelter per square foot of metal (two surfaces) uniformly distributed over the surface of the sheets of metal. It shall be applied in such a manner that the spelter will not peel off during fabrication, or in transportation, or in laying the pipe, and any uncoated spots due to poor workmanship, rough handling, or any other reason, shall be sufficient cause for rejecting the pipe. The amount of spelter per

Section 40

square foot will be determined as described in the standard method of sampling and testing of the American Society for Testing Materials.

(c) Identification.—Each section of a pipe shall bear the name of the sheet manufacturer, the brand, or trade mark, and the gauge. This identification shall be stamped on the sheets by the manufacturers of the sheet. Pipe having any sections not so stamped shall be rejected. The manufacturer of the pipe shall roll the sheet so that the identification shall appear on the outside of each section.

(d) Manufacture.—All pipes shall be circular in section, unless otherwise specified, of lap joint construction, and all joints shall be tightly riveted so that the jointed pipe shall be straight, true, and rigid.

The corrugations shall not be more than $2\frac{3}{4}$ inches wide and not less than $\frac{1}{2}$ -inch deep.

The diameter of the metal pipe shall be understood to be the clear diameter. Pipe culvert from 16 feet to 30 feet long, inclusive, may be shipped in 2 sections, and pipe culverts longer than 30 feet shall be shipped in such lengths that no section is less than 12 feet long.

(e) Dimensions and Weight.—The length of the sheets before forming, the gauge of the uncoated metal, and weight per foot of the finished pipe, shall be not less than shown in the following Table. All gauges are United States Standard gauge (U.S.S.G.) and a 5% maximum variation either way from the theoretical weight will be allowed in any sheet. The total weight of any culverts containing 100 sheets or more shall not under-run the theoretical weight by more than 5%.

Nominal Diameter Inches	Length of Sheet Before Forming Inches	Minimum Gauge U. S. Standard Uncoated Metal	Weight per Foot Finished Culvert Pounds
12.....	41	16.....	10.8
15.....	50	16.....	13.1
18.....	60	16.....	19.3
24.....	79	14.....	25.4
30.....	98	14.....	43.6
36.....	117	12.....	52.0
42.....	136	10.....	75.6
48.....	156	10.....	88.1
60.....	2-98.....	8.....	136.8

Where pipe is to be placed under fills 20 feet or more in depth, the gauge of the sheets may be increased, such increase to be noted on the plans or in the Special Provisions.

(f) Rivets and Riveting.—Rivets shall not be less than $5/16$ inch in diameter for sheets No. 14 gauge or lighter, and they shall not be less than $3/8$ inch for sheets heavier than 14 gauge. All rivets shall be thoroughly galvanized or sherardized.

Longitudinal joints shall be riveted in each outside groove, and for pipes of 30-inch diameter or larger, double riveted in each outside groove. In the transverse joints, rivets shall be placed uniformly not more than 6 inches apart.

Round heads of rivets shall have a diameter of not less than 1.5 times the diameter of the rivet, plus $\frac{1}{8}$ inch, and flat heads shall have a thickness of not less than $\frac{6}{10}$ of the diameter of the rivet.

(g) Asphaltic Coating.—When an asphalt coating on the pipe is required, it shall be coated with asphalt at the plant before being shipped. The quality and character of the dip, and the method of application shall be such that the coating on the pipe shall be tough and pliable and shall adhere firmly to the galvanizing.

(h) Coupling Bands.—Field connections shall consist of bands not less than 7 inches in width, made from the same material as the pipe. They may be fitted with malleable cast iron lugs, or with angles having minimum dimensions of $1\frac{1}{2}'' \times 1\frac{1}{2}''$ and of a length equal to the full width of the band, and provided with galvanized bolts not less than $\frac{1}{2}$ inch in diameter. The connections shall be so fabricated that a firm connection of the sections of pipe may be made easily in the field.

SECTION 41

CAST IRON

(a) General.—All cast iron shall be made from a superior quality of gray iron. It shall be of such character as to make a casting that will be tough, strong, sound, and of even grain, and shall comply with the requirements of the A.S.T.M. Standard Specifications for Gray Iron Castings, Designation A-48. The tensile test will not be required.

(b) Test Bars.—The Contractor shall cast and furnish test bars for the transverse test as provided in the above Specifications. At least one bar shall be cast from each heat or run of metal. These bars must be poured, and must represent true samples of the iron used in the castings.

(c) Rejection of Materials.—Should the results of any test fail to meet all the requirements herein specified, all castings made from the melt or blow which the specimens represent will be rejected.

(d) Cleaning and Inspection.—All castings passing the above tests shall be thoroughly cleaned inside and out without the aid of acid or other liquid, and shall be subjected to careful inspection and hammer tests. The castings shall be of the dimensions shown on the drawings, and shall be free from sand or blow holes and cold shuts. No plugging or stopping of holes will be allowed.

After the casting has been cleaned and tested as described above, it shall be weighed. The weight shall vary from that indicated on the plans by not more than 8 per cent for individual castings, nor more than 4 per cent on the whole lot of castings.

If the casting meets the tests as above described, then the weight shall be painted in white paint on the outside of the casting. Unless otherwise specified, no casting will be accepted on the work unless the weight is plainly marked thereon.

The Contractor shall assume full responsibility for the correctness and condition of all patterns, whether furnished by him or borrowed from the City.

(e) **Marking.**—Each casting shall have distinctly cast on the outside thereof such letters and numbers as the Engineer may direct. The letters and numbers shall be not less than 1½ inches in length and ⅛ inch in relief, unless otherwise specified.

SECTION 42
CAST STEEL

(a) **General.**—Steel Castings shall comply with the requirements of the A.S.T.M. Specifications for Carbon-Steel Castings for Miscellaneous Industrial Uses, Grade B, Serial Designation A27, supplemented by the following paragraphs:

(b) **Chemical Composition.**—Steel used for the castings shall conform to the following requirements as to chemical composition:

Manganese, max., per cent.....	1.00
Phosphorus, max., per cent.....	0.05
Sulphur, max., per cent.....	0.06

(c) **Physical Properties.**—The castings shall conform to the following minimum requirements as to tensile properties:

Tensile Strength min., lb. per sq. in.....	70,000
Yield point min., lb. per sq. in.....	38,000
Elongation in 2 in., min. per cent.....	24
Reduction of area, min. per cent.....	36

(d) **Test Specimens.**—The Contractor shall deliver to the Engineer at least one test specimen from each melt or blow.

Each test piece shall be cut cold from coupons to be moulded and cast in some portion of one or more castings, and shall receive the same treatment as the casting before the specimen is cut out, and before the coupon is removed from the casting.

(e) **Rejection of Materials.**—The Contractor shall, at his own expense, provide and finish all test pieces. The testing of the materials will be made by the City Engineer without expense to the Contractor.

(f) **Cleaning and Inspection.**—All castings which have passed the required tests shall be thoroughly cleaned inside and out, without the aid of acid or other liquid, and shall be subjected to careful inspection and hammer tests. The castings shall be of the dimensions shown on the drawings, sound and free from all defects or imperfections which may render them unfit for use.

Upon passing the above tests, castings shall be weighed and the weight shall vary not more than 5 per cent of that indicated on the plans for any particular casting, and not more than 3 per cent on the total number of castings. The weight of each casting shall be painted in

white on the outside thereof. Unless otherwise specified, no casting will be accepted on the work unless the weight is plainly marked thereon.

(g) **Patterns.**—The Contractor shall assume full responsibility for the correctness and condition of all patterns, whether furnished by him or borrowed from the City.

(h) **Marking.**—Every casting shall have distinctly cast on the outside thereof such letters and numbers as the Engineer may direct. These letters and numbers shall be not less than $1\frac{1}{2}$ inches in length and $\frac{1}{8}$ inch in relief, unless otherwise specified.

SECTION 43

STRUCTURAL, RIVET AND EYEBAR STEEL

All structural, rivet, and eyebar steel shall comply with the requirements of the A.S.T.M. Standard Specifications for Steel for Bridges and Buildings, Designation A7, supplemented by the following paragraphs:

Steel made by the acid-bessemer process shall not be used.

Test specimens of structural, rivet or eyebar steel shall show a fracture having a silky or fine granular structure throughout with a bluish gray or dove color, and shall be entirely free from granular, black or brilliant specks.

Finished rolled material shall be free from cracks, flaws, injurious seams, laps, blisters, ragged and imperfect edges, and other defects. It shall have a smooth, uniform finish, and shall be straightened in the mill before shipment.

Material shall be free from loose mill scale, rust pits, or other defects affecting its strength and durability.

SECTION 44

WROUGHT IRON

When wrought iron is specified, it shall comply with the requirements of the appropriate current Standard Specifications of the A.S.T.M., among which are the following:

“Rolled Wrought-Iron Shapes and Bars”

A.S.T.M. Designation

A-207

“Wrought-Iron Plates”

A.S.T.M. Designation A-42

“Uncoated Wrought-Iron Sheets” A.S.T.M. Designation A-162

“Zinc Coated (Galvanized) Wrought-Iron

Sheets”

A.S.T.M. Designation A-163

“Welded Wrought-Iron Pipe”

A.S.T.M. Designation A- 72

SECTION 45

REINFORCING STEEL

(a) Bars-General.—Reinforcing steel shall be manufactured, in accordance with, and shall in all respects comply with the requirements of the A.S.T.M. Standard Specifications for Billet Steel Concrete Reinforcement Bars, Designation A-15.

All bar reinforcement shall be open hearth steel of the structural grade, rolled from new billet stock and shall consist of deformed bars. No re-rolled material shall be used.

Deformed bars shall be such as to provide a net section at all points equivalent to that of a plain round or square bar of equal nominal size.

(b) Sampling.—Reinforcing steel will be sampled by the Engineer either at the mill or at the work, or both.

Steel submitted for sampling either at the mill, or on the work, shall be identified by heat or melt number, and accompanied by mill analysis and test reports. Two or more samples, each 24 inches long, shall be taken at random from each size in each melt or heat. All test samples shall be furnished by the Contractor without charge to the City.

When steel is purchased from mills outside the United States of America, it shall be inspected at the mill, and the entire cost of this inspection shall be borne by the Contractor, who will be required to deposit with the Director of Public Works sufficient funds to cover the cost of such mill inspection.

(c) Cleaning.—Before being placed, reinforcing steel shall be thoroughly cleaned of mill and rust scale, mortar, oil, dirt, and of coatings of any character that will destroy or reduce the bond.

(d) Bending.—Reinforcing steel shall accurately conform to the dimensions shown on the plans. The radius of bends shall be 4 or more times the least diameter of the bar.

(e) Straightening.—Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks or sharp bends shall not be used.

(f) Placing.—Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in position by wiring at intersections with No. 14 wire, and by using concrete or metal chairs, spacers, metal hangers or supporting wires, furnished by and at the expense of the Contractor. The use of wooden supports is prohibited and metal supports which extend to the surface of the concrete shall not be used. Placing bars on layers of fresh concrete as the work progresses, and adjusting the bars during the placing of con-

crete will not be permitted. When pieces of reinforcing bars are used as separators, as in the case of beams and girders, these bars shall be paid for at the unit price bid for reinforcing steel.

In no case shall the clear distance between parallel bars be less than $1\frac{1}{2}$ inches, nor shall the embedment in the concrete be less than the distance shown on the plans. Where this distance is not shown, it shall be understood to be 2 inches. This latter requirement will be rigidly enforced, and should tests show that reinforcing is closer to surface than specified, the Contractor will be required to remedy this defect in a manner satisfactory to the Engineer, and at the expense of the Contractor.

(g) Splicing.—Girder bars shall not be spliced. Splices of tensile reinforcement at points of maximum tensile stress shall be avoided. Where bars are spliced they shall have a lap of at least forty diameters.

(h) Inspection.—No concrete shall be deposited until the Engineer has inspected the placing of the reinforcing steel and given permission to place concrete. All concrete placed in violation of this provision will be rejected.

(i) Steel Wire Fabric.—Steel wire fabric shall be galvanized, and shall be fabricated from steel wire which complies with the requirements of the A.S.T.M. Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, Designation A 82.

The fabric shall be electrically welded at all joints or points of intersection and shall be composed of No. 3 gauge steel wires placed 3 inches center to center transversely, and No. 8 gauge steel wires placed 16 inches center to center longitudinally. Where fabric is spliced the lap shall be not less than one mesh.

(j) Mesh Reinforcement for Pavement.—Mesh reinforcement shall be galvanized, and shall be fabricated from steel wire which complies with the requirements of the A.S.T.M. Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, Designation A 82.

Mesh reinforcement shall be welded at all joints, or points of intersections, and so constructed that the sheet will retain its original shape during the necessary handling. Unless otherwise specified, the mesh reinforcement shall be electrically welded, 6" x 6" mesh, No. 6 wire 0.192 inch diameter, 42 pounds per hundred square feet. All reinforcement shall be held firmly in place against vertical or transverse movement. In splicing mesh reinforcement, the lap shall not be less than 1 mesh.

(k) Measurement and Payment.—Bar reinforcement shall be measured by the pound. The quantity to be paid for shall be the

Section 46

amount of bar reinforcement actually placed in accordance with the specifications, calculated from the unit weights in the following table:

Size of bar in Inches	Weight, Pounds per Foot	
	Square Deformed	Round Deformed
1/4"		0.167
3/8"		0.376
1/2"	0.850	0.668
5/8"		1.043
3/4"		1.502
7/8"		2.044
1"	3.400	2.670
1 1/8"	4.303	
1 1/4"	5.313	

The price paid per pound for bar reinforcement in place shall be full compensation for furnishing, hauling, bending and placing all reinforcing steel, furnishing all tie wire and supporting devices, and doing all incidental work.

No additional payment will be made for furnishing and installing steel wire fabric and the cost thereof shall be included in the price paid for the structure incorporating such fabric.

The price paid per square foot for mesh reinforcement shall be full compensation for furnishing and installing, and for all supporting devices and incidental work. The quantity of mesh to be paid for shall be measured by the number of square feet of pavement actually reinforced with mesh, and no allowance will be made for laps.

SECTION 46

CAST IRON PIPE AND FITTINGS

Cast iron pipe, with bell and spigot ends, shall be in accordance with the Federal Specification for Cast Iron Water Pipe (Bell and Spigot), WW-P-421 dated July 21, 1931, and subsequent revisions; fittings therefore shall be in accordance with the American Water Works Association's Standard Specifications for Cast Iron Water Pipe and Fittings.

Cast iron pipe with flanged ends, and flanged fittings, shall be in accordance with the above A.W.W. Association specifications and with the American Standards Association's Specifications for flanges.

SECTION 47

WELDED WROUGHT-IRON PIPE

Welded wrought-iron pipe shall comply with the requirements of the A.S.T.M. Standard Specifications for Welded Wrought-Iron Pipe, Designation A-72.

Welded wrought-iron pipe shall be galvanized, and shall be marked with the name or trademark of the manufacturer. All pipe 2 inches or more in diameter shall be lap-welded.

SECTION 48

LUMBER AND TIMBER

(a) **Inspection.**—All Redwood lumber and timber shall be inspected by the California Redwood Association without cost to the City. Each piece shall be stamped by the Redwood Association inspector with his personal identification mark as well as with the grade of the material. The Contractor shall furnish the City with the official certificate of inspection issued by the Redwood Association.

All structural lumber and timber, other than Redwood, shall be inspected by the West Coast Lumbermen's Association, or by the Pacific Lumber Inspection Bureau, without cost to the City.

Each piece shall be stamped by the Inspector with his personal identification mark as well as with the grade of the material. The Contractor shall furnish the City with the official certificate of inspection issued by the organization making the inspection.

Redwood, and other lumber and timber, shall be graded and inspected in accordance with, and shall conform to the current grading and dressing rules or specifications of the California Redwood Association and the West Coast Lumbermen's Association, respectively.

Inspection and certification of Redwood, or other lumber and timber, as provided above, will not be required when the quantity of Redwood, or of other lumber and timber, as the case may be, included in the contract, does not exceed one thousand feet board measure.

(b) **Redwood—General.**—Redwood shall be California redwood of the species "Sequoia Sempervirens."

Definitions.

(1) *A pin knot* is one not over $\frac{1}{2}$ " in diameter. An intergrown, encased or pith knot which does not exceed $\frac{1}{2}$ " in diameter shall be classed as a pin knot.

(2) *A pith knot* is a sound intergrown knot with a pith hole not more than $\frac{1}{4}$ " inch in diameter.

(3) *A sound knot* is solid across its face, as hard as the surrounding wood, and shows no indications of decay. It may vary in color from red to black and must be entirely surrounded by wood.

(4) *A knot cluster* is two or more knots grouped together as a unit with the fibers of the wood deflected around the entire unit. A group of single knots is not a cluster knot.

(5) *Knots* shall be considered as being grouped when two or more knots are closer than twice the sum of their least diameters.

(6) *A corner knot* is a knot which extends through the corner of the piece and is not entirely surrounded with wood.

(7) *The diameter* of a corner knot is the width of the knot measured along the corner of the stick.

(8) *The size* of a knot shall be defined as follows :

On narrow face of joists or plank it is the width between lines enclosing knot and parallel to edges of pieces. The only knots measured on narrow faces are those that do not show on wide faces. On wide face the size of knot is the average of largest and smallest diameter of knot.

On narrow face of beam and stringer the size of knot is the width between lines enclosing knot and parallel to edges of piece, except that when a knot on a narrow face extends into the adjacent one-fourth of the width of a wide face, its least dimension is taken as its size. On wide face the size of a knot is its smallest diameter. Knots at edges of wide faces are limited to same sizes as on narrow faces, but measured according to this paragraph.

(9) *The angle of grain* on any face is the angle which the grain of the wood makes with the longitudinal axis of the piece. *Angle of grain* limitations apply only in the middle three-quarters of length and shall be measured over a distance sufficiently great to determine the general slope disregarding slight local deviations.

(10) *Wane is bark*, or lack of wood or bark, from any cause, on edge or corner of a piece.

(11) *Boxed-heart* is the term used when the pith falls entirely within the four faces anywhere in the length of a piece.

(12) *A check* is a lengthwise separation of the wood, the greater part of which occurs across the rings of annual growth.

(13) *Crook* is that distortion in which the edge of the piece is convex or concave longitudinally.

(14) *Oven-dry* is the condition produced by heating at a temperature of 212 degrees Fahrenheit, until there is no observable loss of weight.

(15) *Ring or Annual Growth* refer to the growth layers put on in a single growth year.

(16) *Sapwood* is the layers of wood next to the bark which are lighter in color than the heartwood.

(17) *A shake* is a separation along the grain, the greater part of which occurs between the rings of annual growth.

(18) *A split* is a lengthwise separation of the wood, due to the tearing apart of the wood cells.

Sizes.—Lumber and timber shall be well manufactured, occasional slight variations in size due to sawing being admitted. Rough sizes shall not be smaller than the nominal sizes less $\frac{1}{4}$ ". Dressed dimensions shall be as follows :

Nominal thickness, 2" to 4", S1S or S2S, $\frac{1}{4}$ " off.

Nominal widths, 4" to 7", S1E or S2E, $\frac{1}{4}$ " off, 8" and wider, S1E or S2E, $\frac{1}{2}$ " off.

Nominal thicknesses, 5 inches and thicker, nominal widths, 8 inches and wider, S1S, S1E, S2S, S4S: $\frac{1}{2}$ " off, in the dimensions perpendicular to the surfaced face or faces.

Nominal sizes, 6 x 6 inches and larger; S1S, S1E, S2S, or S4S, $\frac{1}{2}$ " off, in the dimensions perpendicular to the surfaced face or faces.

Stringers, S1E hit-or-miss to nominal width less $\frac{1}{4}$ ".

(c) Dense Select All-Heart Structural Redwood (1400 lb. Bending Stress).—Redwood of this grade shall have an average ring count of not less than 8 nor more than 35 per inch. Material for this grade shall be dense, density being defined as the weight, per cubic foot, of oven dry lumber. Dense Select All-Heart Structural shall have a weight of not less than 24 pounds per cubic foot, oven dry; provided, however, that a tolerance of minus one pound per cubic foot is permitted in occasional pieces.

The angle of grain in the middle three-quarters of any face shall not be greater than one to eighteen (1:18).

The following characteristics, limited as indicated, will be admitted:

Single pin knots in any quantity and in any position, but not in clusters.

Sound, encased or pith knots of maximum size and number as follows:

JOIST AND PLANK 4" & THINNER

Nominal Width	On Narrow Face or at Edge of Wide Face Middle Third of Length	At Center Line of Wide Face
2.....	$\frac{1}{2}$	} On Narrow Face
3.....	$\frac{7}{8}$	
4.....	$1\frac{1}{8}$	
4.....	$\frac{5}{8}$	} At Edge of Wide Face.....
6.....	$\frac{7}{8}$	
8.....	$1\frac{1}{4}$	
10.....	$1\frac{1}{2}$	
12.....	$1\frac{7}{8}$	
14.....	2	
16.....	$2\frac{1}{8}$	
		$1\frac{1}{8}$ $1\frac{5}{8}$ $2\frac{1}{4}$ $2\frac{7}{8}$ $3\frac{3}{8}$ $3\frac{5}{8}$ $3\frac{7}{8}$

The sum of sizes of all knots within middle half of length of any face shall not exceed four and one-half times the size of largest knot allowed on that face.

BEAM AND STRINGER 6" & THICKER

Nominal Width of Face	On Narrow Face, Middle Third of Length	At Center Line of Wide Face
6.....	$1\frac{1}{8}$	$1\frac{1}{2}$ $1\frac{3}{4}$ $2\frac{1}{4}$ $2\frac{3}{8}$ $2\frac{1}{2}$ $2\frac{3}{4}$ $2\frac{3}{4}$
8.....	$1\frac{1}{4}$	
10.....	$1\frac{3}{8}$	
12.....	$1\frac{1}{2}$	
14.....	$1\frac{5}{8}$	
16.....	$1\frac{3}{4}$	
18.....		
20.....		

Section 48

The sum of sizes of all knots within middle half of length of any face shall not exceed four times the size of largest knot allowed on that face.

In material four inches and thinner the size of knots on narrow face and at edges of wide faces may increase proportionately from size permitted in middle third of length to twice that size at ends of piece. Size of knots on wide faces may increase proportionately from size permitted at edge to size permitted along center line.

In material six inches and thicker, the size of knots on narrow faces and at edges of wide faces may increase proportionately from size permitted in middle third of length to twice that size at ends of piece, except that size of no knot shall exceed size permitted along center line of wide face. Size of knots on wide faces may increase proportionately from size permitted at edge to size permitted along center line.

Shakes, checks, and splits will be admitted provided the depth of shake, check or split is not over $1/7$ of the width of the narrow face on the end of the piece, and that it extend from the end a distance no greater than three times the greater dimension of the piece. (This limitation applies only within middle half of height of piece.)

Slight crook will be admitted provided it does not exceed $1/16''$ for each two feet of length.

Sapwood will be admitted provided it does not exceed in width 1" on any face and provided further that it extend in lineal measurement from either end a distance not greater than one quarter the nominal length of the piece.

(d) Select All-Heart Structural Redwood (1200 lbs. Bending Stress).—Redwood of this grade shall have an average ring count of not less than 6 nor more than 50 per inch.

Material for this grade shall be dense, density being defined as the weight, per cubic foot, of oven dry lumber. Select All-Heart Structural shall have a weight of not less than 24 pounds per cubic foot, oven dry; provided, however, that a tolerance of minus one pound per cubic foot is permitted in occasional pieces.

The angle of grain in the middle three-quarters of the length of any face shall not be greater than one to fifteen (1:15). The following characteristics, limited as indicated, will be admitted.

Single pin knots in any quantity and in any position, but not in clusters.

Sound, encased, or pith knots of maximum size as follows:

JOIST AND PLANK, 4" & THINNER

Nominal Width of Face	On Narrow Face, or at Edge of Wide Face, Middle Third of Length	At Center Line of Wide Face
2.....	$\frac{3}{4}$	
3.....	$1\frac{1}{8}$	
4.....	$1\frac{1}{2}$	
} On Narrow Face		
4.....	$\frac{7}{8}$	$1\frac{3}{8}$
6.....	$1\frac{1}{4}$	$2\frac{1}{8}$
8.....	$1\frac{5}{8}$	$2\frac{7}{8}$
10.....	2	$3\frac{3}{8}$
12.....	$2\frac{3}{8}$	$4\frac{3}{8}$
14.....	$2\frac{5}{8}$	$4\frac{3}{4}$
16.....	$2\frac{3}{4}$	5
} At Edge of Wide Face.....		

BEAM AND STRINGER, 6" & THICKER

Nominal Width of Face	On Narrow Face, Middle Third of Length	At Center Line of Wide Face
6.....	$1\frac{3}{4}$	
8.....	$2\frac{1}{8}$	$2\frac{3}{8}$
10.....	$2\frac{3}{8}$	3
12.....	$2\frac{5}{8}$	$3\frac{5}{8}$
14.....	$2\frac{3}{4}$	$3\frac{7}{8}$
16.....	3	$4\frac{1}{4}$
18.....		$4\frac{1}{2}$
20.....		$4\frac{3}{4}$

For provisions on sum of knots and proportionate increase in size, see Subdivision (c).

Shakes, checks, splits, and crook limitations for this grade are the same as for Subdivision (c).

Sapwood will be admitted provided it does not exceed in width one inch (1") on any face.

(e) Bulkhead Structural Redwood (1100 lbs. Bending Stress).—Redwood of this grade shall have an average ring count of not less than 6 nor more than 50 per inch.

The angle of grain throughout the length of the piece shall not be greater than one to ten (1:10).

Material for this grade shall be dense, density being defined as the weight, per cubic foot, of oven dry lumber. Bulkhead Structural shall have an oven dry weight of 24 pounds per cubic foot; provided, however, that a tolerance of minus one (1) pound per cubic foot is permitted in occasional pieces.

Sound, encased, or pith knots of a diameter no greater than $\frac{1}{4}$ the width of the face, are admissible, provided that there be no more than one such knot for each three feet of length of the piece.

An equivalent summation of smaller knots is admissible.

Heart shake with a depth of not over $\frac{1}{7}$ the thickness of piece and a total of not over $\frac{1}{4}$ the length, admissible on one face of occasional pieces.

Section 48

Sapwood will be admitted provided it does not exceed in width 1" on any face.

(f) **Heart Structural Redwood** (1100 lbs. Bending Stress)—Shall be sound wood, free (except as hereinafter provided), from wane, shakes, splits, checks, decayed, unsound or loose knots, cross or badly deflected grain, crook, sap, or other defects which would materially impair its strength or durability, and shall be cut from that portion of old growth trees below the main body of the crown.

Heart Structural Redwood shall have an average ring count of not less than 6 rings per inch.

Material of exceptionally light dry weight shall not be permitted.

The angle of grain in the middle half of the length of any face shall not be greater than one to twelve (1:12).

The following characteristics limited as indicated will be admitted:

Single pin knots in any quantity and in any position, but not in clusters.

Sound, encased, or pith knots not to exceed one maximum knot or equivalent in smaller knots, in each 4 linear feet, with maximum size as follows:

Not exceeding $\frac{1}{4}$ the width of the face on faces under 10".

On face width of 12", knots shall not exceed a diameter of 2.4", when located near its edges or 4" when located on its center line.

Shakes, loose or unsound knots which do not materially impair its strength or durability.

Sapwood not exceeding in width 12% of the width of the face on which it occurs.

(g) **Douglas Fir—General.**—Douglas Fir shall be the Pacific Coast type, "Pseudotsuga Taxifolia."

Douglas Fir ordered in multiple lengths shall be graded after having been cut to length.

Except as otherwise specified, lumber and timber shall contain not less than 75 per cent heartwood.

For lumber and timber which is to be pressure treated with creosote oil or other preservative, there shall be no heartwood requirements and the amount of sapwood shall not be limited.

Definitions

(1) *A knot* in a piece of sawn lumber is a portion of a branch or limb sawn at an angle to its length.

(2) *A spike knot* is one sawn in a lengthwise direction where the end and spiked sections intersect at the edge of the piece and shall be measured only on its end or ends between lines parallel to the edges of the piece on the face on which it occurs.

(3) *Knots* shall be classified according to size, form, quality and occurrence.

(4) *The average* of the maximum and minimum diameters shall be used in measuring the size of knots unless otherwise stated.

(5) *A sound tight knot* shows no indication of decay and is so fixed by growth or position that it will retain its place in the piece. It may be red or black.

(6) *A knot cluster* is two or more knots grouped together as a unit with the fibres of the wood deflected around the entire unit.

(7) *A check* is a lengthwise separation of the wood, which occurs usually across the rings of Annual Growth.

(8) *Close Grain* shall mean an average on either one end or the other of a piece of not less than 6 nor more than 20 annual rings per inch over a 3" line measured at a right angle to the rings located as follows:

In boxed heart pieces the 3-inch line shall be representative, and where the least dimension is 6" or less it shall begin at a distance of 1" from the pith; when the least dimension is more than 6" the 3" line shall begin at a distance from the pith equal to $\frac{1}{4}$ the least dimension of the piece.

In side cut pieces (pith not present) the center of the 3" line shall be at the center of the end of the piece.

Pieces averaging 5 rings or more than 20 shall be accepted if containing $\frac{1}{3}$ or more summerwood.

(9) *A pitch pocket* is a well defined opening between the rings of Annual Growth, usually containing more or less pitch, either solid or liquid.

(10) *A medium pitch pocket* is one not over $\frac{1}{8}$ " in width and not more than 8" in length.

(11) *A skip* is an area on a piece that failed to surface.

(12) *A small skip* is one that the planer knife did not touch on an area equal to the width of the piece and 6" in length, and not more than $\frac{1}{32}$ " deep.

(13) *Slope of grain* is a deviation of the fibre from a straight line parallel to the sides of the piece.

Slight slope of grain is not more than 1" in a length of 15".

Medium slope of grain is not more than 1" in a length of 12".

Moderate slope of grain is not more than 1" in a length of 10".

(14) *Square edged* means that each piece shall be free from wane.

(15) *Torn grain* consists of a part of the wood being torn out.

(16) *Heavy torn grain* is not more than $\frac{1}{16}$ " in depth.

(17) *Boxed heart* means that the pith falls entirely within the four faces anywhere in the length of a piece.

(18) *Vertical grain* means that the annual rings form an angle of not more than 45 degrees from the vertical.

(19) *Variation in sawing* means less or more than the nominal

Section 48

rough green size and must not be confused with intentional scant sawing.

(20) *Slight variation in sawing* is a deviation from the nominal size and shall not exceed the following limits for the respective sizes:

Nominal

1"	1/16" under or 1/8" over
2"	1/8" under or 1/4" over
3" to 7"	3/16" under or 3/8" over
8" and over	1/4" under or 1/2" over

(h) Select Structural Posts and Timbers (1200 lbs. Compression Stress).—Select Structural Posts and Timbers shall be Douglas Fir, 5" x 5" and larger, S1S, S1E, S2S or S4S, 1/2" off each way, shall be in multiples of 2 feet in length, and shall conform to the following Characteristics and Limiting Provisions:

Checks—Seasoning, not to be deeper than 3/8 of the thickness of piece if not opposite each other; if opposite, then combined depths not to exceed above depth.

All pieces to be close grained.

Pitch pockets to be medium.

Sap, not more than 1/4 the width of the four faces, measured over widest point of sap on each face.

Slope of grain, spiral or diagonal, to be not more than 1" in a length of 15".

All pieces to be square edged.

Variation in sawing may be occasional, and slight, in rough stock.

Knots, sound, tight, and not in clusters, shall not exceed the following sizes:

1	" on a 5" face
1 1/4"	on a 6" face
1 1/2"	on an 8" face
2	" on a 10" face
2 1/2"	on 12" and wider faces

A knot other than a spike knot shall be measured on its average dimension on the face on which it occurs. A spike knot shall be measured only on its end or ends between lines parallel to the edges of the piece on the face on which it occurs.

(i) Select Structural Framing, Joists, Plank and Small Timbers (1600 lbs. Bending Stress).—Material of this grade, 2" to 4" thick shall be surfaced 3/8" off in thickness, 3/8" off in width in 4" and 6" widths, and 1/2" off in greater widths, and shall conform to the following Characteristics and Limiting Provisions:

Checks—seasoning, not to be deeper than 3/8 of the thickness of piece if not opposite each other; if opposite then combined depths not to exceed above depth.

All pieces to be close grained.

Pitch pockets to be medium.

Small skips permitted if not opposite each other.

Slope of grain, spiral or diagonal, not more than 1" in a length of 12" in center half of length of piece.

All pieces to be square edged.

Heavy torn grain permitted, not over 1/16" in depth.

Variation in Sawing may be occasional, and slight, in rough stock.

Knots, sound, tight, and not in clusters, shall not exceed the following sizes:

SIZES OF KNOTS

Nominal Width of Face	Within Middle Third of Length		Along Center Line of Wide Face
	On Narrow Face	At Edge of Wide Face	
2".....	1/2"		
3".....	5/8"		
4".....	3/4"	3/4"	1 1/4"
6".....		1"	1 1/2"
8".....		1 3/8"	1 7/8"
10".....		1 3/4"	2 1/4"
12".....		2"	2 1/2"
14".....		2 1/4"	2 3/4"
16".....		2 1/2"	3"

The size of knots at edges of wide faces may increase proportionately toward the end of the piece from the size allowed in middle one-third of length to the size permitted along center line of wide face and on narrow face to twice the size allowed in middle one-third.

Knots shall be measured in accordance with the rules of the West Coast Lumbermen's Association.

(j) **Select Structural Beams and Stringers** (1600 lbs. Bending Stress).—Material of this grade, 5" and thicker, and 8" and wider, shall be S1S, S1E, S2S or S4S, 1/2" off each way and shall conform to the following Characteristics and Limiting Provisions:

Checks—Seasoning, not to be deeper than 1/4 of the thickness of piece if not opposite each other; if opposite then combined depths not to exceed above depth.

All pieces to be close grained.

Pitch pockets to be medium.

Sap not to exceed 2" on narrow faces and 3" on wide faces, measured over widest point of sap on each face.

Slope of grain, spiral or diagonal, not more than 1" in a length of 15" in center three fourths of length of piece.

All pieces to be square edged.

Variation in sawing may be occasional and slight in rough stock.

Knots, sound, tight, and not in clusters, shall not exceed the following sizes:

SIZES OF KNOTS

SIZES OF KNOTS		
Nominal Width of Face	On Narrow Face and at Edge of Wide Face— Middle 1/2 of Length in 24 Feet & Shorter, Middle 2/3 of Length in Over 24 Feet	Along Center Line of Wide Face
5"	1"	
6"	1¼"	
8"	1½"	1¾"
10"	1¾"	2¼"
12"	1¾"	2½"
14" and wider	2"	3"

SECTION 49

TIMBER PILES

(a) **General.**—Timber piles shall be Douglas Fir (*Pseudotsuga taxifolia*) and shall be fresh cut from straight, sound, live timber, free from wind shakes or rotten knots, or sufficient small or large knots to impair the strength or durability of the pile. Piles shall be free from damage by borers or other destructive agency. All bark shall be removed, and all knots shall be smoothly dressed close to the body of the pile. No pile, the grain of which makes one complete turn in less than 35 feet, shall be accepted.

Piles having short or reverse bends or kinks will not be accepted.

They shall be so straight that a straight line from the center of the butt to the center of the tip shall lie wholly within the body of the pile, and they shall have a uniform taper from butt to tip.

The average number of annual rings, measured radially over an area beginning 2 inches from the center of the heart of the pile, shall be not less than 6 rings per linear inch.

(b) **Dimensions.**—Timber piles shall be square sawed at butt and tip. They shall have a butt diameter of not more than 20 inches. The minimum tip and butt diameters of piles of various lengths shall be as follows:

Length of Pile in Feet	Min. Butt Diameter, Inches	Min. Tip Diameter, Inches
0 to 24 inclusive.....	12.....	8
25 to 44 ".....	13.....	8
45 to 64 ".....	14.....	8
65 to 74 ".....	15.....	8
75 to 89 ".....	16.....	8
90 to 119 ".....	16.....	7
120 or more.....	16.....	6

The diameter 3 feet from the butt shall be not more than 1 inch less than the butt diameter.

The diameter of a pile at any section shall be the average diameter at that section, measured at right angles to the axis of the pile. Any diameter exceeding the least diameter at the section by more than 10 per cent shall be neglected in determining the average.

PART III STREETS AND HIGHWAYS

SECTION 100

GRADING

(a) General.—Under grading are included the excavating, loading, transporting, depositing and consolidating of the materials to bring the existing surface to the required elevations, also all grubbing, clearing and disposal of obstructions, grass, shrubs, trees, stumps, trash and debris, construction of necessary drainage ditches and all other necessary incidental work. No extra payment will be made for any such incidental work, unless otherwise expressly provided under the contract.

Grading shall be done in conformity with the lines, elevations and grades shown on the plans. When elevations and grades are not shown on the plans, all streets or portions of streets, including sidewalks, which are to be graded shall be graded to subgrade in conformity with the official grades.

Slopes of excavations and embankments shall be finished true, smooth, and straight in conformity with the lines, grades and slopes set by the Engineer, and as shown on the plans.

The surfaces of streets abutting the work shall be sloped so as to render them safe and passable for traffic.

Drainage ditches shall be constructed where necessary to protect the work.

All foundations and abandoned sewers and appurtenances within the limits of the work shall be removed or cut down to an elevation three feet below subgrade.

All shrubs, trees, branches, roots, trash and other unsatisfactory materials shall be removed from the work and disposed of by the Contractor. No materials shall be dumped on private or public property without proper authority.

In conformity to Part II, Chapter X, Article 8, Section 373 (Ordinance No. 3540—Series of 1939) of the San Francisco Municipal Code there shall be no limitation on the use of labor-saving devices except at the locations, if any, specified in the Special Provisions, provided however that when, during construction operations, an additional location is revealed where, in the judgment of the Engineer, such limitation is necessary to avoid public nuisance or protect public health, safety or facilities, then such additional location shall be deemed to have been specified in the Special Provisions and the additional expense caused to the contractor by a limitation on his operations in such additional location shall be estimated and paid for as Extra Work in accordance with the provisions of Section 10 (b) of the Standard Specifications.

(b) Excavation.—All excavation in excess of that needed for fills

and construction of embankment to the required cross-section shall be removed from the work and disposed of by the Contractor.

(c) Embankment.—Material for embankment shall be earth or sand, or rock with sufficient earth or sand to fill completely the voids between pieces of rock, and shall be free from perishable material. Unless otherwise specified, the fill or embankment shall be constructed in layers not exceeding 12 inches in thickness, and shall be well compacted by watering or rolling, with three-wheeled power rollers or tamping rollers, or by both watering and rolling, as may be ordered by the Engineer, and shall be carried to such a height as may be necessary to provide for shrinkage and settlement. The roller shall weigh not less than 12 tons. Tamping rollers shall be used on fills over 5 feet deep, and shall have tamping feet about 7 inches long and of about 8 square inches cross-sectional area. The load applied by the feet shall be not less than 50 pounds per square inch. Loaded hauling equipment shall be routed over the whole width of fills so as to equalize the compaction. Where rolling is impracticable, the fill shall be deposited in layers not over 6 inches in thickness and thoroughly tamped with heavy iron tampers. All clods or hard lumps of earth shall be broken up before being placed in fill, if such treatment is necessary to obtain a dense embankment or a smooth even surface. All grass, shrubs, trees, stumps, trash and debris shall be removed from the area to be filled before any fill is deposited thereon.

Where fill is to be made on a side hill or against an existing fill, the slopes thereof shall be thoroughly plowed before depositing the fill material thereon.

In street intersections requiring fill, the fill must extend 3 feet beyond the property lines extended before any curb, sidewalk, or pavement is constructed thereon.

(d) Side Sewers, Manhole Castings, Etc.—All side sewers, within the limits of the work, that are less than four feet below curb grade shall be reconstructed between the main sewer and the curb in accordance with the specifications. Where necessary, temporary connections shall be made between the curb and the property line. Such work shall be done as expeditiously as possible and the side sewers shall be kept in service at all times. All frames or heads of manholes, catchbasins, valve boxes, sewer vents, inlets, or any other frames or castings within the limits of the work which are not at the proper elevations shall be reset to conform to the finished surface grades. No additional payment will be made for this work.

(e) Pavement Excavation.—When the Proposal includes "Pavement Excavation" as one of the bid items, this item shall include all required or necessary excavation and removal of existing foundations, concrete or asphaltic walks, pavements, concrete slabs, curbs, basalt blocks, walls, manholes, catchbasins, ties, tracks, brickwork, reinforced concrete, and the like within the limits of the work; the back-filling of the excavations after completion of removal operations; and all incidental work.

Unless otherwise specified, such old foundations, concrete or asphaltic walks, concrete slabs, curbs, basalt blocks, manholes, catch-basins, masonry, and brickwork, within the limits of the work shall be excavated and removed to a depth of three feet below subgrade, except on side slopes where they shall be excavated to a depth of one foot beneath the face of the slope. The fill necessary to replace such excavation shall be made in accordance with Subdivision (c) of this Section. Abandoned pits, vaults, and basements, under pavement or sidewalk areas shall be backfilled with sand and watered so as to obtain maximum compaction.

“Pavement Excavation” shall be paid for at the unit price bid therefor, and the quantity to be paid for shall be the actual volume of the materials in place. In the excavation of tracks in paved areas, the quantity of Pavement Excavation shall include the total volume down to the bottom of ties and within the nominal track area—10 feet wide for single track, and 20 feet wide for double track. The ties shall be the property of the Contractor, but not the rails or appurtenances.

(f) **Measurement.**—Quantities of excavation and embankment shall be measured by the method of average end areas, and shall include only the volumes lying within the lines of the street.

The finished elevation at platform or landing shall be considered the grade in computing quantities of excavation for stairways.

(g) **Payment.**—Unless a unit price bid for excavation or embankment is included in the proposal, no direct payment will be made for grading, and the Contractor shall include the cost thereof in the price bid for pavement, or other appropriate item. If the proposal includes a unit price bid either for excavation, or for embankment, payment will be made only for such bid item, but not for both excavation and embankment.

The Contractor’s attention is directed to the fact that the price bid per cubic yard for excavation of concrete for retaining walls, steps, or other structure shall include the excavation and backfill therefor below the official line and grade; and where the official lines and grades are not given, below the elevation as shown on plan for steps or wall.

“Pavement Excavation” shall be paid for as provided in Subdivision (e), above.

SECTION 101

SUBGRADE FOR PAVEMENT

(a) **General.**—Areas to be paved shall be prepared to form a subgrade, true to grade and cross-section, at the proper depth below the required surface of the finished pavement. Except as otherwise shown on the plans, or required, the elevation and cross-section of the subgrade shall be such that the finished pavement surface will be 6 inches below the top of curb at the gutter, and will have a crown of 1.0, 0.8 or 0.6 per cent of the street width between curbs, when the street grade is 0 to 3 per cent, 3 to 6 per cent, or over 6 per cent, respectively.

Section 101

The grade of the subgrade shall not be raised or adjusted so as to compensate for anticipated settlement under the weight of the pavement.

All perishable or unsound material, tree stumps, existing pavements, foundations, wet clay, wet loam, or any other unsound sub-base material, shall be removed from the sub-grade and replaced with sound material, well compacted into place. The entire surface of the subgrade shall be compacted by rolling and tamping, by the use of water, or by both watering and rolling. The rolling shall be done by a power roller weighing not less than 10 tons. The rolling shall continue until a compact and uniform surface is obtained. Where the subgrade is too sandy to be rolled, it shall be compacted by water.

Should any of the existing curbs be off line or grade, they shall be straightened by the Contractor at his own expense, even though they were not constructed by him, before pavement materials are placed adjacent thereto.

To insure a proper subgrade, the Contractor, just previous to placing the pavement, shall provide a template of the proper length, rigidly constructed, and having spikes spaced 3 inches center to center, and of such length that when the template is held on the headers, the ends of the spikes shall be at subgrade. This template shall be used for the detection of irregularities in the subgrade.

No pavement of any kind shall be placed on any section of the work until the subgrade for that section is complete and properly examined for grade, and found to be correct.

Unless otherwise specified, 200 linear feet of subgrade shall always be prepared in advance of the paving operations. After the subgrade has been accepted, barricades shall be so placed that no equipment or traffic of any kind will be allowed thereon.

Where necessary, the subgrade shall be thoroughly wet just in advance of laying the pavement.

(b) Procedure at Manholes.—In order to insure a true pavement surface at City manholes, and so that the castings will not interfere with the finishing machine, the following procedure shall be followed when constructing pavement with a mechanical spreader or finishing machine. The castings shall be removed and each manhole opening shall be surrounded by a five foot square box to the depth of the pavement. The pavement shall be temporarily omitted in the enclosed area.

When traffic is to be allowed over concrete base, the omitted areas shall be temporarily paved as follows. After completion of the adjacent concrete base, and pending the resetting of frames and covers, each boxed out area shall be temporarily paved with asphaltic concrete wearing surface, 1 inch thick, on red rock macadam laid on 2-inch planks over the manhole opening. Both the macadam and wearing surface shall be compacted with a hand roller.

After the adjacent pavement has been constructed the manhole frames and covers shall be set to conform accurately to the finished pavement grade, after which the omitted concrete base and wearing surface shall be completed.

The same procedure shall be followed at each manhole of a public utility company except that in such cases the castings will be removed by the company after the Contractor has done the excavation, and will also be reset to the proper grade by such company.

When it is necessary for a utility company to lower a vault, and the construction of the pavement base in such area is thereby delayed, the Contractor shall box out the entire vault area and, upon completion of the vault, provide temporary pavement as specified above.

In no case shall a manhole casting, nor any valve casting, be covered over, even temporarily.

No extra payment will be made for this work, and the cost thereof shall be included in the price bid for the appropriate pavement item or items.

(c) **Payment.**—No direct payment will be made for preparing subgrade, the cost of which and all incidental work shall be included in the unit price bid for the pavement.

SECTION 102

CONCRETE CURB, ARMORED

(a) **Subgrade.**—The subgrade for the curb shall be prepared in accordance with the applicable requirements of Section 101, and at the level of the subgrade of the adjacent pavement or gutter. When a macadam sub-base is to be provided for the adjacent pavement in accordance with the provisions of Section 118, and if the curb be constructed prior to the laying of such sub-base, then the subgrade for the curb shall be level with the bottom of such sub-base; if the sub-base is laid prior to the construction of the curb then the sub-base shall be extended to a line 18 inches behind the curb line and shall be the required subgrade for the curb.

(b) **Forms.**—The forms shall be smooth on the edges and on the sides against which the concrete is placed. They shall be of sufficiently heavy material to be rigid, and shall be set accurately so that the curb, when completed, shall conform accurately to the lines and grades given. No concrete shall be placed before the forms are in position for at least 50 feet ahead, or for the entire length of curb to be placed. They shall be thoroughly cleaned before each setting. All wooden forms shall be wetted before concrete is deposited against them. Except as otherwise shown on the plans, or required, the top of the curb shall be 6 inches above the adjacent gutter.

The forms shall extend to the full depth of the curb and all joints must be tight and even. On the front, the plank or metal must be of one piece to a depth of 3 inches below the gutter grade. The forms must be so set that the finished curb will be 6 inches wide on top, extend at least to the full depth of the pavement, and have a batter on the back of 1 inch in 6 inches. The front face shall be vertical.

(c) **Concrete.**—The concrete shall be Class “C” as specified in Section 28.

(d) **Armor.**—The curb shall be protected by a curb bar complying with the requirements of Section 29.

(e) **Plaster Facing.**—The facing shall be Class A mortar, as specified in Section 27, without the addition of lamp black.

Lampblack shall be added when curb is constructed between existing curbs in the construction of which lampblack was used.

(f) **Placing Concrete.**—After the subgrade and the forms have been prepared as specified above, concrete shall be deposited in the forms to a depth of 6 inches and thoroughly spaded and tamped. The facing or plaster shall then be placed against the front form to a depth of 2 inches below the gutter line and $\frac{3}{4}$ of an inch thick. A second layer of concrete shall then be put in the forms, taking care that the plaster shall not be disturbed. The concrete shall be deposited to such a depth that when thoroughly spaded and tamped it shall be 1 inch below the finished grade of the curb. After placing the curb bar in its proper position, along the top outside edge of the curb, plaster shall be added to a depth of 1 inch and thoroughly worked so that it will bond with the concrete and have a true and uniform surface. In no case shall more than 45 minutes elapse between the mixing of the concrete and covering same with the plaster.

(g) **Construction Joints.**—One-eighth inch construction joints shall be cut through the curb at each street line and at intervals of 10 feet along the block, except for a short distance from the end the interval may vary between 5 and 10 feet. In circular curbs, the construction joints shall be so spaced that the perimeter shall, unless otherwise specified, be divided into equal lengths of not more than 10 feet, or less than 5 feet. The joints along the straight curb shall be perpendicular to the top and face of the curb, and those along circular curbs shall be on radial lines. The edges at the joints shall be rounded to $\frac{1}{8}$ inch radius. The plates used in making construction joints must be of the exact cross-section of curb.

(h) **Finishing.**—After the concrete has sufficiently set, the front form shall be removed, and the face and top of the curb worked with a wooden float until the plaster has been thoroughly bonded with the concrete, and the surface is smooth and uniform in texture and free from humps, sags, or inequalities. When edging the rear of the curb, especial care shall be taken that no lip or shoulder is left between the rounded edge and back form.

The curb shall be depressed at automobile runways or driveways. The fall across the curb at the driveways shall not be less than $\frac{3}{4}$ of an inch. The length of the driveway depression shall be 9 feet exclusive of side slopes, except where property owners request otherwise, but shall not exceed 30 feet in length.

(i) Side Sewer and Y-Branch Locations to be Marked on Curb.—

The letter “S” shall be stamped in the top of the curb over each side sewer which is not yet in service, as required in Section 158 (c).

The letter “Y” shall be stamped in the top of the curb opposite each Y-branch from which a side sewer has not been constructed.

(j) Contractor's Name on Curb.—

The Contractor shall stamp his name and the year on the curb face at the beginning and end of each block. The letters shall be at least $\frac{3}{4}$ of an inch high and shall be impressed to a depth of $\frac{1}{4}$ inch.

(k) Street Names.—

In the face of all concrete curbs at street intersections, the names of the intersecting streets shall be impressed in the same manner as that specified for concrete sidewalks in Section 108 (h).

(l) Protection and Curing.—

As soon as the back forms have been removed, or within 24 hours after the concrete has been poured, the back of the curb shall be protected with earth to the full height of the curb. Where sidewalk area is below grade, the back of the curb shall be temporarily protected (until the sidewalk area has been brought to grade) with earth to the full height of the curb and with a berm at least 18 inches wide.

The concrete shall be cured as specified in Section 28 (e).

(m) Repairs and Replacements.—

The contractor shall repair all curbs, sidewalks, and gutters damaged by him. Where any curb requires repairs before acceptance, the repair shall be made by removing and replacing the entire section between joints and not by refinishing the damaged portion. Where the plans provide for the reconstruction of existing curb and the limit of the new work specified does not fall on a curb joint, the new curb shall join the old curb at the first curb joint beyond the said specified limit.

(n) Payment.—

Concrete curb, armored, shall be paid for at the price bid per linear foot which shall include full compensation for all incidental work.

SECTION 103

CONCRETE CURB, UNARMORED

Unarmored curb shall comply with the requirements for Concrete Curb, Armored, specified in Section 102, modified as follows:

Curb bar shall not be used.

The front face of the curb shall have a batter of 1 in 4 and the back face shall be vertical.

The concrete shall be well spaded away from the forms so that there will be no rock pockets in either the front or back surface of the curb. No plaster will be required.

The front forms shall not be removed in less than 2 hours nor more than 6 hours after placing concrete therein. The back forms shall not be removed until all finishing has been completed.

Section 104

Immediately after removing the forms, the face and top of the curb shall be given a brush coat of grout made by adding sufficient water to Class A mortar. The above surfaces shall then be floated until the surface is true and even and of a uniform color. No lamp black shall be used.

The front and back edges of the top of the curb shall be rounded to a radius of approximately $\frac{3}{4}$ inch. Particular care must be taken that these edges are straight and to a true grade.

The concrete shall be cured as specified in Section 28 (e).

Conforms to adjoining vertical curb shall be made with a 2-foot transition from battered to vertical face.

SECTION 104

WHITE CONCRETE CURB

White concrete curb shall conform to the requirements for Concrete Curb, Armored, in Section 102, modified as follows:

The front face of the curb shall have a batter of 1 in 4 and the back face shall be vertical.

No curb bar shall be used.

The plaster for the front face and top of the curb shall comply with the requirements for Class "A" mortar except that White Cement, and Olympia sand, or equal, shall be used.

Finishing shall be done with a steel trowel.

White concrete curb adjacent to concrete parking strip pavement shall be constructed monolithic therewith, the angle at the gutter being finished with a 2-inch radius. In such cases the concrete used shall be the same as that used in the pavement, otherwise it shall be Class C.

The Contractor shall protect the curb from stains or discoloration from any cause. Any curb so discolored shall be removed, and replaced between construction joints, by the Contractor at his own expense.

SECTION 105

COMBINED CURB AND GUTTER

(a) **General.**—Combined curb and gutter shall be constructed of Class C concrete, and shall comply with the requirements and dimensions shown on the plans.

Side sewer locations shall be marked on the curb in accordance with the requirements of Sections 102 (i) and 158 (c).

(b) **Subgrade.**—The subgrade shall be prepared to the level of the subgrade of the adjacent pavement. Where the material in the street is not suitable for a foundation, it shall be removed and replaced with sand or other suitable material. When the curb is to rest on a fill, the material of which the fill consists shall be thoroughly compacted,

and shall extend at least 3 feet behind the face of the curb at subgrade level.

When a macadam sub-base is to be provided for the adjacent pavement, the subgrade for combined curb and gutter shall comply with the provisions of Section 102 (a).

(c) **Forms.**—The forms shall be smooth on the edges and on the sides against which the concrete is placed. They shall be of sufficiently heavy material to be rigid, and shall be securely set so that the curb, when completed, shall conform accurately to the lines and grades given. Forms shall be in place at least 50 feet in advance of the concrete, or for the entire length of the curb to be placed. The forms shall be thoroughly cleaned before each setting, and all wooden forms shall be wetted before concrete is deposited against them.

(d) **Concrete.**—Concrete shall be Class C, as specified in Section 28.

(e) **Placing Concrete.**—The concrete shall be placed in the forms in layers not over 6 inches thick, and thoroughly spaded and tamped before the next layer is added. The top layer of concrete shall be so tamped that an excess of mortar will be brought to the surface. Particular attention shall be given to spading the concrete close to the forms in order to prevent honeycombing and so that the exposed surface shall have a smooth and uniform appearance.

(f) **Construction Joints.**—Construction joints shall be constructed at intervals of 10 feet. These joints shall be formed with 3-ply roofing paper cut to the shape of curb and gutter, and so placed and supported that joints shall be straight, vertical, to the full depth of the curb and gutter, and at right angles to line of the curb or radial. After the concrete has set, the roofing paper shall be cut so that the exposed surface shall be $\frac{1}{4}$ inch below the exposed surface of the curb and gutter.

The edges of these construction joints shall be rounded with an edging tool having a radius of $\frac{1}{8}$ inch.

(g) **Finishing.**—When the concrete has set sufficiently the exposed surfaces shall be given a brush coat of grout, made with Class A mortar, and floated to a smooth and even surface with a wood float. The edge of the gutter shall be rounded with an edging tool having a radius of $\frac{1}{8}$ inch.

(h) **Protection and Curing.**—The concrete shall be cured by means of an impervious membrane as specified in Section 28 (e) or as follows. As soon as the concrete in the curb and gutter has sufficiently set, it shall be covered with burlap and kept wet for 7 days. The Contractor may, after 24 hours, replace the burlap with straw, sawdust, or earth, kept thoroughly wet, until the expiration of the 7-day period.

As soon as the back form is removed, or within 48 hours after the concrete has been poured, the back of the curb shall be protected with earth to the full height of the curb and with a berm at least 3 feet wide.

(i) **Payment.**—Combined Curb and Gutter shall be paid for at the price bid per linear foot which shall include full compensation for all incidental work.

SECTION 106

STONE CURB

(a) **Material.**—Stone curb shall be made from California Granite, free from defects or flaws that might impair its usefulness as curb.

(b) **Dimensions.**—Each piece of curb shall be at least 4 feet long, 6 inches thick at top and bottom, and 16 inches deep.

(c) **Dressing.**—The top of the curb and its face for a depth of 6 inches shall have a first class pien-hammered finish. These surfaces shall be true and properly squared, and have no holes. A tolerance of $\frac{1}{4}$ inch will be allowed in width of top of curb. The back of the curb, for a depth of 2 inches, shall be pointed to a fair surface, free from inequalities exceeding $\frac{1}{2}$ inch, when measured from a straight edge. The joints of the curb shall show an even edge for a depth of 8 inches, and shall be kept full. The joints below the dressed portion shall not be pitched more than $\frac{1}{4}$ inch under square. The joints throughout the dressed portion of the ends shall not exceed $\frac{1}{4}$ inch. All edges bordering dressed surfaces shall be sharply defined.

Where gutters are deeper than 6 inches, the face of the granite curb shall be pien-hammered to the full depth of the gutter. The lower part of each stone shall be roughly squared, and shall have an average thickness of not less than 6 inches at the bottom and at no point shall the thickness be less than 4 inches.

The curb for corners shall be cut to the prescribed curved lines, with joints on true radial lines. The joints between the several blocks of stones shall not exceed $\frac{1}{8}$ inch.

(d) **Placing.**—All curbs shall be set to true lines and grades as shown on plans. Where the subgrade is not suitable for the purpose of supporting the curb, it shall be removed and replaced with sand, gravel, or concrete. When properly in place, the back of the curb shall be supported by earth for its full height and, where the sidewalk area is below grade, with a berm at least 18 inches wide.

(e) **Payment.**—Stone curb shall be paid for at the price bid per linear foot, which shall include full compensation for all incidental work.

SECTION 107

REDWOOD CURB

(a) **General.**—Redwood curb including posts, shall be constructed of "Heart Structural" redwood, 4 inches in thickness, 16 inches wide, and not less than 6 feet in length. The curb shall be carefully set to the line and grade shown on the plans, and shall be sup-

ported by 4" x 4" x 3' redwood posts set at not more than 6 feet centers. The curb shall be securely spiked to these posts. All joints shall be "butt" and shall be made only at the posts.

(b) **Payment.**—Redwood curb shall be paid for at the price bid per linear foot, which shall include full compensation for all incidental work.

SECTION 108

CONCRETE SIDEWALK — TWO COURSE

(a) **General.**—Two-course concrete sidewalk shall consist of a concrete base 3 inches thick, and a mortar finishing coat $\frac{1}{2}$ inch thick. The concrete shall be Class "F" as specified in Section 28.

(b) **Subgrade.**—The subgrade shall be prepared by grading to a depth of at least $3\frac{1}{2}$ inches below the required elevation of the sidewalk surface. The subgrade shall be thoroughly tamped or, if sand, shall be compacted with water.

(c) **Forms.**—Side strips used as forms shall be 2 inches in thickness, and not less than $3\frac{1}{2}$ inches in depth, and shall have a smooth, straight upper edge. They shall not be removed in less than 12 hours after the finishing coat has been completed.

(d) **Slope.**—Unless otherwise specified, the finished surface of the sidewalk shall rise $\frac{1}{5}$ inch per foot from curb grade to property line.

(e) **Construction.**—Immediately before placing concrete, the forms and subgrade shall be thoroughly wetted. Concrete shall be deposited to such a depth that when it is thoroughly tamped its surface shall be $\frac{1}{2}$ inch below the top edge of the forms. The surface of the concrete base must be smooth and uniform, and free from voids or rock pockets.

(f) **Finishing coat.**—Immediately after the concrete base has been placed, a finishing coat of cement mortar $\frac{1}{2}$ inch thick shall be applied. The mortar shall be Class "A" as specified in Section 27 and shall be colored with lamp black in the amount of $\frac{1}{8}$ pound to each sack of cement. Immediately after the finish coat has been spread over the concrete base it shall be thoroughly worked into the base and struck off with a straight edge.

When the finishing coat has sufficiently set, it shall be floated to a true and uniform surface with a steel trowel, after which the smooth surface shall be brushed transversely across the sidewalk with a bristle brush to produce a uniform, non-skid, texture. On grades over 10 per cent a rougher surface will be required. This may be accomplished by lifting the wooden float straight up from the surface of the walk. The adhesion of the mortar to the float will produce a surface which resembles a miniature relief map of a mountain range.

The surface shall be marked into rectangles not less than 2.5 feet, or more than 4' on a side. These markings shall be made at every construction joint in the curb and the intervening space shall be marked off in equal flags.

(g) Expansion Joints.—Expansion joints shall be constructed by placing the concrete against an expansion joint filler suitably supported perpendicular to the subgrade. The filler shall be $\frac{1}{4}$ -inch thick, and as specified in Section 33.

Transverse expansion joints shall be spaced not more than 20 feet apart, and shall be opposite the construction joints in concrete curb. They shall extend across the entire width of walk, shall be at right angles to the curb line, and shall extend through the full thickness of the sidewalk. Transverse expansion joints shall be provided across sidewalk opposite the points of beginning and end of all curb returns.

Where sidewalk abuts building foundation walls, copings, or any rigid structure, an expansion joint shall be provided between such structure and the sidewalk. Where sidewalk abuts curb, the back of the curb for a depth of $3\frac{1}{2}$ inches from the top shall be painted with a heavy coat of emulsified asphalt, except at curb returns. At curb returns, expansion joints shall be constructed between the curb and abutting sidewalk.

Where a length of sidewalk construction ends against existing sidewalk, expansion joints shall be constructed, except that when such length is less than 25 feet, an expansion joint shall be required at one end only.

(h) Street Names.—On all sidewalks constructed at street intersections the names of the intersecting streets shall be impressed, opposite the crosswalk or crosswalks, in letters or figures 4 inches high and $\frac{1}{2}$ of an inch deep, as shown on Plan L-402.

(i) Contractor's Name on Sidewalk.—The Contractor shall stamp his name, and the year, on the sidewalk at the beginning and end of each block, or shorter section constructed by him. The letters shall be $\frac{3}{4}$ of an inch high and impressed to a depth of $\frac{1}{4}$ -inch.

(j) Curing.—The concrete shall be cured as specified in Section 28 (e).

(k) Payment.—The area of concrete sidewalk as constructed shall be paid for at the price bid per square foot, which shall include the cost of all incidental work.

SECTION 109

CONCRETE SIDEWALK — ONE COURSE

One course concrete sidewalk shall be constructed in accordance with the provisions of Section 108, except as modified below:

The concrete shall be Class "F" as specified in Section 28, and

shall be $3\frac{1}{2}$ inches in thickness. Immediately after the concrete has been placed it shall be thoroughly tamped so that the mortar will flush to the top, and the surface shall then be struck off with a straight edge. While the concrete is still fresh, dry Class A mortar, as specified in Section 27, colored with $\frac{1}{8}$ pound of lamp black per sack of cement, shall be added to the surface of the sidewalk. Only sufficient dry mortar shall be added to properly color the surface. This mortar shall be thoroughly worked into the concrete so as to produce a homogeneous mass.

SECTION 110

REDWOOD HEADERS

(a) **General.**—Redwood headers shall be of “Heart Structural” grade, shall be 2 inches thick and of a width equal to the thickness of the pavement, or of the macadam sidewalk, which they are to bound. They shall be placed on edge, and securely nailed inside of supporting stakes driven into the subgrade. These supporting stakes shall be of such size and number as may be necessary to rigidly support the headers in place during the construction operations. All stakes shall be set with their sawed tops conforming with the surface of the finished pavement or walk. All stakes shall be redwood of “Heart Structural” grade. The planks shall have squared top edges and squared butt joints against the stakes. The planks shall be held in place with at least 2 nails of the necessary length in each stake, except at butt joints where not less than 4 shall be used. In sandy or loose soil, or wherever necessary to hold headers to proper line and grade, the joints in the headers shall be reinforced with a 1" x 6" x 18" redwood scab, securely nailed.

Headers shall be placed where indicated on the plans, also along the unprotected edges of all pavements, and of macadam sidewalks, even though not called for on the plans.

Unless a price is asked in the bid items, the cost of header strips shall be included in the unit price paid for pavement.

(b) **Payment.**—No direct payment shall be made for headers, and the cost thereof shall be included in the price paid for the adjacent pavement or macadam walk.

SECTION 111

CONCRETE PAVEMENT

(a) **Subgrade Headers.**—On the subgrade, prepared as specified in Section 101, temporary header boards, 2 inches thick, and of a width equal to the thickness of the pavement, shall be constructed so as to form parallel lanes or strips not more than 14 feet wide. The thickness of the pavement at the sides or edges of these strips shall be increased 2 inches, and shall taper to the normal or specified thickness of the pavement at a distance of 2 feet from the edges of the strip. If

an approved concrete finishing machine is used, these strips may be 20 feet wide, and the headers shall be 3 inches thick. The headers shall be surfaced, constructed true to line and grade, and so supported by stakes, blocking, or tamping, that there shall be no lateral or vertical movement of the headers while the concrete is being spread or finished. All joints in these temporary headers shall be toenailed and reinforced with 1" x 6" x 2' scabs securely nailed. After the header boards have been erected, a scratch template, as specified in Section 101, supported by the headers, previously poured concrete strips, or both, shall be dragged the full length of the strip or lane to check the grade and cross-section. High spots shall be cut down to the correct plane, and low spots filled and thoroughly compacted.

The scratch template must be constructed so as to form an exact template for that portion of the crown curve included within the limits of the particular strip being checked. Only on subgrade thus treated may concrete be deposited.

The cost of these temporary header boards shall be included in the price bid per square foot of pavement.

At least 200 feet of subgrade shall always be prepared in advance of the mixer. After the subgrade for any strip has been accepted, barricades shall be so placed that no equipment or traffic of any kind shall be allowed thereon.

(b) Concrete.—The concrete shall be Class E as specified in Section 28.

(c) Headers.—Where curbs do not exist, headers shall be constructed in place thereof to the proper line and grade, as provided in Section 110, except that when a finishing machine is used, such headers shall be 3 inches thick.

(d) Placing and Spreading.—Immediately before placing concrete the subgrade and headers shall be watered with a spray nozzle to the extent that they will not absorb any moisture from the concrete. Care shall be taken to prevent the formation of pools on the subgrade by the excessive use of water. On the subgrade prepared and moistened as above specified, concrete shall be deposited to the required depth which, unless otherwise specified, shall be 6 inches. The method of placing shall comply with the requirements of Section 28 (b).

Where practicable, the concrete pavement shall be spread and kneaded with an approved mechanical spreader. Where a mechanical spreader is not used, the concrete shall be tamped and struck off in accordance with the provisions of Section 112 (c).

Immediately after placing the concrete adjacent to headers and joints, it shall be well spaded to insure a uniform density.

(e) Finishing.—Following the operations specified above, the concrete shall be finished with a rigid straight edge float, not more than 18 feet, or less than 16 feet in length, having a smoothing surface from 8 to 10 inches in width. This straight edge shall be used with its length parallel to the center line of the pavement and shall be operated

from bridges with a combined longitudinal and transverse motion, planing off the high places and filling in depressions.

The surface shall then be floated with a light wood float, from 16 to 18 feet long, 6 to 8 inches wide, and from $\frac{1}{2}$ to 1 inch thick. It shall be equipped with reversible handles at each end. The float shall be operated from bridges with its length parallel to the center line of the pavement, and shall be dragged transversely across the pavement with its forward edge raised slightly so the smoothing may be done by the back edge. The finishing last above specified shall not be done until the concrete has become slightly sticky. This will require the finishers to remain on the work for a considerable length of time after the mixing has stopped so that the concrete will have sufficiently set before being given the final finish.

The finished pavement shall be to the required grade and cross section, and shall not vary from the required surface more than $\frac{1}{8}$ -inch in 10 feet.

The top edges of the concrete at all contact joints between adjacent strips, at expansion joints, at dummy joints, and at construction joints, shall be rounded with an edging tool of $\frac{1}{4}$ -inch radius. The edging tool used on the second edge placed at contact and construction joints shall have a vertical lip $\frac{1}{4}$ -inch longer than that used on the first edge. Great care shall be exercised, by the use of a straight edge or other means, to insure in all cases straight joints of uniform width. Joints shall be clean, and no fins of mortar shall be left therein. Expansion joint filler shall not protrude above the pavement. The surface across all joints shall be tested for uniformity of grade and no variation from the true grade will be permitted on either side of any joint.

(f) Expansion Joints.—Expansion joints shall be formed by placing the concrete against an expansion joint filler rigidly and suitably supported perpendicular to the subgrade. Unless otherwise specified in the Special Provisions, the filler shall be Clear All Heart Finish grade redwood boards having an oven dry weight of not more than 25 lbs. per cubic foot. Each board shall be accurately cut so as to extend from the subgrade to a uniform depth of 1-inch below the pavement surface. Each transverse joint shall be made with a single board across the full width of the lane being placed. Boards for longitudinal joints shall be at least 16 feet long. A temporary strip, 1" deep and of the same width as the board, shall be lightly nailed thereon. The joints shall be finished as specified above, and the nails shall be removed. Next day the 1-inch strip shall be removed, and the resulting groove in the pavement filled with hot asphalt as specified for dummy joints below.

Transverse expansion joints shall be straight, at right angles to, or radial from, the center line of the pavement, and shall be spaced 60 feet apart. Transverse joints in adjacent strips shall be staggered at least five feet. The filler for transverse expansion joints shall be $\frac{3}{4}$ of an inch thick.

A longitudinal expansion joint shall be constructed along the center line of the pavement, provided that, when a concrete pavement

is constructed in three or more lanes, a longitudinal expansion joint shall be provided between each adjacent pair of lanes. The filler for the longitudinal joint shall be $\frac{1}{2}$ -inch thick.

(g) Dummy Joints.—At intervals of 20 feet between transverse expansion joints, dummy joints shall be constructed with steel bars and drivers made especially for this purpose. Driving the bar into the concrete with sledge hammers will not be permitted. These joints shall be $\frac{1}{4}$ -inch wide and 2 inches deep, straight, and at right angles to both the center line and the surface of the pavement. On curves, they shall be constructed on radial lines. After the groove has been made, its edges shall be rounded off with an edging tool as specified above. Care must be taken so that the pavement on opposite edges of the joint shall be at a correct elevation in order that a smooth riding joint may be obtained.

The following day the joint shall be thoroughly cleaned and filled with hot asphalt (air blown, 20 to 30 penetration). Care shall be taken to protect the edges of the joint.

(h) Construction Joints.—At the beginning and end of every pavement strip not in contact with existing pavement, at the end of each day's run, or where the depositing of concrete is interrupted for a period of 30 minutes or more, a construction joint shall be placed. The construction joint shall be formed by finishing the pavement square across the strip against a special header, 3 inches in thickness, and of a width equal to the depth of pavement. This header shall conform to the correct shape of the pavement, shall be placed perpendicular to the subgrade, and its top shall be at the correct pavement grade. Upon the resumption of work, surplus concrete on the subgrade shall be cleared away, and the header shall be removed in such a manner as to avoid damage to the edge of the concrete.

(i) Contractor's Name on Pavement.—At the beginning and at the end of each block, and on any isolated section constructed under the contract, there shall be stamped in the fresh pavement, the year of construction, and the contractor's name. The letters shall be not less than 2 inches in height, and shall be impressed to a depth of $\frac{3}{8}$ of an inch.

(j) Protection and Curing.—Concrete pavement shall be cured and protected in accordance with the provisions of Section 28 (e).

(k) Coloring Concrete Pavement.—When specified in the Special Provisions there shall be incorporated with the mix, 5 pounds of Venetian Red to one sack of cement. The Venetian Red shall contain 20% of red oxide of iron, and shall be added to the cement and aggregates before mixing. The cost of such coloring shall be included in the price bid for pavement.

(l) Payment.—Concrete pavement shall be paid for at the price bid per square foot, which shall include full compensation for all incidental work.

SECTION 112

CONCRETE BASE, TYPE A

(a) **Subgrade, Headers.**—When the subgrade has been prepared as specified in Section 101, temporary header boards, 2 inches thick, and of a width equal to the depth of the concrete base, shall be constructed so as to form parallel lanes or strips not more than 14 feet wide. If an approved concrete finishing machine is used, these strips may be 20 feet wide, and the headers shall be 3 inches thick. The headers shall be surfaced, constructed true to line and grade, and so supported by stakes, blocking, or tamping, that there shall be no lateral or vertical movement of the headers while the concrete is being spread or finished. All joints in these temporary headers shall be toenailed and reinforced with a 1" x 6" x 2' scab securely nailed. When the pavement does not abut against a curb, gutter or other pavement, redwood headers shall be furnished and installed as provided in Section 110.

Unless otherwise specified, Concrete Base, Type A, shall be 6 inches thick.

After the header boards have been erected, a scratch template as specified in Section 101, supported by the headers, previously poured concrete strips, or both, shall be dragged the full length of the strip or lane to check the grade and cross section. High spots shall be cut down to the correct plane, and low spots filled and thoroughly compacted.

At least 200 feet of subgrade shall always be prepared in advance of the mixer. After the subgrade for any strip has been accepted, barricades shall be so placed that no equipment or traffic of any kind shall be allowed thereon.

No adjustment shall be made in the subgrade to allow for anticipated settlement under the pavement load, and no extra payment shall be made for additional concrete used, or claimed to have been used on account of such settlement.

(b) **Concrete.**—Concrete Base, Type A, shall be Class "E" concrete, as specified in Section 28, and unless otherwise specified shall be 6 inches thick.

(c) **Placing.**—After the concrete has been deposited in accordance with the provisions of Section 28, it shall be spread to the required thickness, grade and cross-section.

If an approved concrete finishing machine is not used, the concrete shall be tamped with a transverse tamper until the mortar flushes up, and the surface is dense and smooth. Should there be any rock pockets or voids in the surface after tamping, they shall be immediately grouted with a thin mortar composed of 1 part cement to 3 parts sand.

The tamper shall be at least 1 foot longer than the width of the strip, 6 inches in width, and shall be accurately shaped to conform to the crown of the pavement, and be of rigid construction. It shall be equipped with plow handles at either end, and operated in a direction at right angles to the center line of the pavement. While one end of the

Section 113

tamper is held stationary, the man at the other end shall tamp the concrete, advancing slightly with each downward motion of the tamper. When he has advanced his end of the tamper about 12 inches, he shall then hold it stationary while the man at the other end tamps in a similar fashion.

(d) Construction Joints, Contact Joints.—The provision, construction, and finishing of construction joints, and of contact joints, shall comply with the requirements therefor as specified for Concrete Pavement in Section 111. Expansion Joints shall not be constructed in Concrete Base.

(e) Dummy Joints.—Dummy, or weakened plane, joints shall be constructed by means of a 1½-inch by 4-inch wood filler set on the subgrade, as shown on the plans. Dummy joints shall be at right angles to, or radial from, the center line of pavement, and shall be spaced at 20-foot intervals.

(f) Curing.—Concrete base shall be cured and protected in accordance with the provisions of Section 28 (e).

No asphaltic wearing surface shall be put on the concrete base until 10 days after the base has been placed, and no concrete base shall remain uncovered for more than 14 days.

(g) Payment.—No direct payment will be made for concrete base, and the cost thereof shall be included in the price paid for the pavement of which it is a part.

SECTION 113

CONCRETE BASE, TYPE B

(a) General.—The subgrade for the concrete base shall be prepared as specified in Section 101, and in Subdivision (b) below.

The concrete base shall be laid in 30-foot lanes where space permits, and shall be finished with an approved mechanical finishing machine.

Unless otherwise specified, Concrete Base, Type B, shall be 8 inches thick.

The procedure at manholes shall be as specified in Section 101 (b).

(b) Steel Side Forms, Subgrade.—Steel side forms of approved design shall be used. They shall weigh not less than 10 pounds per linear foot, shall be of required depth in one piece, and shall have a base width of not less than 8 inches. The forms shall be in perfect repair, clean, straight, and of uniform section.

A special foundation of macadam, 6 inches thick and 3 feet wide, constructed in accordance with the Standard Specifications, shall be prepared for the forms. Sound red rock may be used. The macadam shall be thoroughly rolled, and be true to grade.

The forms shall be placed on the macadam, in perfect line and grade. They shall be stayed as rigidly as possible, and shall then be

backed with earth, not sand, to within an inch of the top of the forms. The earth backing shall have a minimum width of 2 feet at the top and 3 feet at the bottom, and shall be thoroughly compacted.

After the forms are securely set to line and grade, the subgrade shall be checked with the scratch template specified in Section 101 (a). The template shall be supported on the forms, previously poured concrete strips, or both, and shall be dragged the full length of the subgrade to check the grade. High spots shall be cut down to grade and low spots filled and thoroughly consolidated.

The scratch template must be constructed so as to form an exact template for that portion of the crown curve included within the limits of the particular strip being checked. Only on subgrade thus treated may concrete be deposited.

No adjustment shall be made in the subgrade to allow for anticipated settlement under the pavement load, and no extra payment shall be made for additional concrete used, or claimed to have been used, on account of such settlement.

(c) Joints.—The provision, construction and finishing of Construction Joints, and of Contact Joints, shall comply with the requirements therefor as specified for Concrete Pavement in Section 111.

Dummy joints shall be constructed by means of $\frac{1}{2}$ -inch by 4-inch wood filler as specified for Concrete Base, Type A, in Section 112 (e).

Expansion joints shall not be constructed in Concrete Base.

(d) Concrete.—Concrete Base, Type B, shall be constructed with Class E concrete, mixed at the site of the work, and as specified in Section 28.

(e) Placing Concrete.—After the subgrade has been wetted in the manner set forth in Section 111 (d), the concrete shall be deposited in conformity with the provisions of Section 28 (b), and shall be tamped and finished with an approved mechanical finishing machine.

The finishing machine must be in perfect operating condition.

Initial and secondary screeds must definitely hold their crown as set.

Coordination of forward speed of the machine and length of the lateral movement of screeds must be such as to prevent the ridging of the finished concrete surface.

The finished surface of the concrete base shall be perfectly smooth, free from texture disfigurations caused by the use of long-handle floats or any other type of equipment or tools used to remove surface defects. These tools may be used, but after their use, a final pass must be made with the finishing machine.

The finishing machine must back up and recut pavement surface as many times as is necessary to establish a true and even crown and surface area over the entire pavement.

The final finish shall be accomplished by the use of burlap, leather or acceptable type of flexible drag, attached properly to the rear of the finishing machine, and always used on the final pass over any one area to leave the concrete surface in ridgeless, even and uniform sur-

Section 114

face. This feature of the concrete placing must be carefully executed and will be rigidly enforced.

The concrete shall be evenly distributed in front of the finishing machine to prevent the finishing machine from being unevenly loaded, and to prevent unequal loads against the front cut-off screed.

On all grades over 4 per cent, the concrete finishing machine shall be operated uphill.

(f) Protection and Curing.—Concrete base shall be cured and protected in accordance with the provisions of Section 28 (e).

No asphaltic concrete wearing surface shall be placed on concrete base until 10 days after the base has been placed, and no concrete base shall remain uncovered for more than 14 days.

(g) Payment.—No direct payment will be made for concrete base, and the cost thereof shall be included in the price paid for the pavement of which it is a part.

SECTION 114

CONCRETE CENTER STRIP PAVEMENT

(a) General.—Concrete center strip shall be constructed with Class E concrete as specified in Section 28, of the width shown on the drawings, and unless otherwise specified, shall be 6 inches thick. The edges of the strip shall be 8 inches thick, decreasing to 6 inches at a point 2 feet from the edges of the strip. The Contractor may first construct either the center strip or the adjacent pavement, but in no case shall the Contractor be allowed to construct both types of pavement at the same time.

(b) Subgrade.—The subgrade shall be prepared as specified in Section 101.

(c) Placing.—If the adjacent pavements have not been constructed previously, forms or headers shall be substantially constructed and shall conform to the required line and grade.

The concrete shall be deposited between the forms or headers, struck off with a template and thoroughly tamped with a transverse tamper until the mortar flushes up and the surface is dense and even.

(d) Finishing.—After the concrete has been tamped and evened up, it shall be floated with wooden floats, and finished, as specified in Section 111 (e).

(e) Joints.—The provision, construction and finishing of expansion joints, of construction joints, and of contact joints, shall comply with the requirements therefor as specified for Concrete Pavement in Section 111, except that no longitudinal expansion joint shall be constructed.

(f) **Contractor's Name in Pavement.**—The Contractor shall stamp his name, and the year in the pavement, as provided in Section 111 (i).

(g) **Curing and Protection.**—The center strip of concrete shall be cured and protected as provided in Section 28 (e).

(h) **Payment.**—Concrete center strip pavement shall be paid for at the price bid per square foot, which shall include full compensation for the thickened edges, and for all incidental work.

SECTION 115

BRICK PAVEMENT

(a) **General.**—Brick pavement shall consist of a brick wearing surface set in a mortar bed on a concrete base, Type A, 6 inches thick, constructed in accordance with the provisions of Section 112.

(b) **Brick.**—The bricks shall be Paving Bricks as specified in Section 37.

(c) **Mortar Bed.**—The mortar bed shall be Class A mortar, as provided in Section 27, except that it shall be mixed without water and used dry. After the concrete base has been thoroughly cleaned, the dry mortar shall be uniformly spread over it and struck off with a template so that the resulting mortar bed shall be $\frac{1}{2}$ -inch thick. The template shall be of substantial construction, and its lower edge shall be formed and dressed so as to produce the correct crown and surface on the mortar when the template is dragged over the same between guides properly placed.

The template shall be made to bear at all times on the guides, and for this purpose should be equipped with rollers or skids at the ends.

(d) **Laying Brick.**—The mortar bed as above described shall be lightly sprinkled in advance of laying brick.

The bricks shall be sorted and culled at the piles before being delivered to the brick layers. No dirty bricks shall be permitted in the pavement, and care shall be used to secure bricks of approximately the same size and degree of hardness in the same locality. The bricks shall be carried from the piles to the brick layers in clamps or pallets, by hand or by mechanical conveyors. No wheeling of bricks in barrows over those already laid, will be permitted.

The bricks shall be carefully laid on the mortar bed in straight, parallel courses at right angles with the axis of the street. They shall be laid flat, with the better surface exposed, and in a manner which will secure an even pavement surface, conforming to the required crown and a firm bed for each brick.

Nothing but whole bricks shall be used, except in starting and finishing a course and around covers for street structures. In no case shall less than $\frac{1}{2}$ bricks be used. The bricks shall be laid with close joints at

ends and sides, and the adjacent courses shall break end joints for at least 3 inches. Each course shall be laid complete from end to end in one continuous operation, and shall not vary from a straight line more than 1 inch in 20 feet. The bricks shall be carefully cut and fitted, in a workmanlike manner, around all castings, which have previously been brought to grade, and the adjustments of the castings and the finishing of the pavement shall be done so as to present a smooth surface to traffic. The bricks, after once having been laid, shall not be disturbed for any purpose, except to replace poor bricks with acceptable bricks. The inspection for this purpose shall follow closely on the bricklaying so that all such defects may be remedied before the mortar has set. All brick not conforming to the requirements of these specifications shall be classed as poor brick. All joints shall be left open and clean to the full depth until grouted.

(e) Expansion Joints.—Longitudinal expansion joints $\frac{3}{4}$ of an inch wide shall be constructed next to the curbs. The expansion joint shall extend to the full depth of the brick.

The expansion joint filler shall be as specified in Section 33. On brick center strip pavement, longitudinal expansion joints will not be required.

(f) Grouting.—After all the defective bricks have been replaced with sound bricks and the pavement has been brought to a true and even surface conforming to the required grade and crown and swept clean, but before the mortar has had time to set, the bricks shall be sprinkled with water and the joints filled with Portland cement grout.

The mortar shall be Class "A", as provided in Section 27, to which sufficient water shall be added to produce a grout of the consistency of thin cream.

From the time the water is applied until the last drop of grout is removed and floated into the joints of the pavement, the mixture must be kept in constant motion. Before the grout is applied, the bricks shall be thoroughly wet by being lightly sprayed.

The grout shall be deposited on the pavement in front of the sweepers, who shall rapidly sweep it lengthwise of the bricks with stiff stable brooms into the unfilled joints until the joints are filled. After the grout has had time to settle into the joints, but before the initial set develops, every joint shall be completely filled with a thicker grout, and if necessary, refilled until joints remain full to the top.

After this application has had time to settle and before the initial set has taken place, the pavement shall be finished where possible to a smooth surface with a squeegee or wooden scraper, having a rubber edge, which shall be worked over the pavement at an angle with the joints. All excess mortar shall be removed from the surface of the brick pavement.

(g) Protection.—When completed and after the cement has received its initial set, the pavement shall be covered with a layer of sand or loam 1 inch thick, which shall be frequently sprinkled. No travel shall be permitted on the pavement for a period of at least 7

days after the grouting, or longer, as the Engineer may require on account of weather conditions.

Ample barricades and watchmen shall be provided for the proper protection of the grouting.

(h) Payment.—Brick pavement shall be paid for at the price bid per square foot, which shall include the cost of the concrete base and all incidental work.

SECTION 116

SPRAY COAT

Spray coat shall consist of asphaltic cement as specified in Section 31, and shall be used to prepare any surface on or against which an asphaltic concrete course is to be laid, except earth, macadam, or a preceding asphaltic course of the same pavement.

Before application, the asphaltic cement shall be heated to such a temperature that it can be sprayed on the surface to be treated in a smooth, thin, and even coat. In applying the spray coat every effort shall be made to obtain the thinnest possible coating consistent with complete coverage of the surface. Should, from any cause, an excess of the spray coat be applied, that excess shall be immediately removed. Spray coat shall be applied by spraying, and not with a broom or in any similar manner.

Under no circumstances shall the spray coat be allowed to become dirty, nor shall the asphaltic concrete course be laid more than five hours after the application of the spray coat.

Curbs, sidewalk, and gutters shall be protected from spray coat, and any asphaltic cement sprayed on them or other adjoining improvements shall be immediately cleaned off. The edges of existing asphalt paving, manhole covers and catchbasin frames, valve covers, etc. against which asphaltic concrete materials are to be placed shall be given a spray coat.

No direct payment shall be made for spray coat, and the cost thereof shall be included in the price bid for the pavement, or other item which requires its use.

SECTION 117

ASPHALTIC CONCRETE WEARING SURFACE

(a) General.—Asphaltic concrete wearing surface shall, unless otherwise specified, be 2 inches thick, and shall consist of asphaltic cement, and mineral aggregate composed of coarse aggregate, sand and stone dust. The use of diatomaceous earth will not be permitted. The percentage by weight of each material shall be as set forth below.

In general, the four types of asphaltic concrete wearing surface are intended for use as follows: Type A on highways and streets with heavy traffic; Type B or Type BB, as specified in the special provisions,

Section 117

on residential streets and those with light traffic ; Type C for conform pavement.

The asphaltic cement and stone dust shall comply, respectively, with the requirements of Sections 31 and 32.

The sand, except that used for Type BB, shall be that commonly known as "Antioch" sand, or shall be an approved equal, and shall comply as to quality with the requirements of Section 23, and shall be within the grading limits set forth below. The sand used for Type BB shall comply, as to both quality and grading, with the requirements of Section 23.

The coarse aggregate shall comply as to quality with the requirements of Section 24 and shall be so graded as to yield the specified mix.

(b) Grading and Proportions of Materials.—Asphaltic concrete wearing surface shall be graded and mixed in the proportions tabulated below, and shall be of the type specified in the special provisions, shown on the plans, or required.

The sand for Types A, B and C shall be graded as follows:

Sieve Size	Percentage by Weight Retained on Each Sieve and Passing the Sieve Next Above
1/4".....	0
No. 10.....	0 to 2
No. 40.....	18 to 24
No. 80.....	38 to 44
No. 200.....	30 to 36
Passing No. 200.....	2 to 8

The materials shall be mixed in the following proportions by weight, expressed as percentages of the total mixture including the asphalt:

Sieve Size	Percentage by Weight Retained on Each Sieve and Passing the Sieve Next Above			
	Type A	Type B	Type BB	Type C
	Min. Max.	Min. Max.	Min. Max.	Min. Max.
1 1/2".....	0	0	0	0
1 1/4".....	2-5	16-20	3.5- 4.0	12-18
3/4".....	8-10	13-15	39.0-41.0	20-25
1/4".....	30-33	8-10	17.0-18.0	42-50
No. 10.....	10-12	44-48	33.0-35.0	
Sand.....	30-35			
Stone Dust (Total Passing No. 200).....	5- 8	5- 8	0.0- 1.0	8-10
Asphaltic Cement..	6- 7	6- 7	3.5- 5.0	7- 8
Total.....	100	100	100	100

The exact proportions shall be subject to control by the Engineer and may be varied within the limits set forth in this section.

(c) Mixing.—The asphaltic cement shall be heated in a kettle of approved type, and maintained at a temperature between 275° and 300° Fahrenheit. The heat must be so applied that there can be no

burning of any portion of the asphaltic cement. No live steam shall be injected into the cement.

The mineral aggregate shall be heated in an approved appliance to a temperature of not less than 275° nor more than 375° Fahrenheit. After heating to the required temperature, the mineral aggregate shall be screened into four sizes and each size shall be kept in a separate bin. Each bin shall have an overflow vent to prevent materials from overflowing into adjacent bins. One of these bins shall be used for sand and the other three for broken stone or gravel.

The screens shall be of such capacity and so arranged that the three larger mesh screens will screen out at least 90% of the material coming to them, and the small screens at least 85% of the material coming to them. The stone dust, hot sand, and coarse mineral aggregate shall then be mixed in the proper proportions, and to these shall be added the required amount of asphaltic cement, heated to the proper temperature. This mass shall then be mixed for not less than 45 seconds in a suitable apparatus, so as to effect a thoroughly homogeneous mixture. All proportions shall be measured by weighing. The scales shall register direct without the application of any factor. The correctness of the scales shall be certified by the Sealer of Weights and Measures of the City as provided by law, or more frequently when necessary to insure their accuracy.

(d) Spray Coat.—All surfaces on or against which asphaltic concrete wearing surface is to be placed shall first be given an asphaltic cement spray coat as specified in Section 116, except the surface of water-bound macadam, and except the clean surface of any course of asphaltic materials laid within the preceding 24 hours.

(e) Laying Wearing Surface.—The mixture as above prepared, shall be brought to the work in suitable vehicles at a temperature of not less than 275° Fahrenheit nor more than 325° Fahrenheit. Tarpaulins shall be provided and used upon all loads.

The wearing surface shall be spread with an approved mechanical finishing machine equipped with a tamping mechanism and a receiving hopper for the materials, or with an approved mechanical finishing machine having a satisfactory raking attachment. Temporary headers used in conjunction with the finishing machine shall be furnished at the expense of the Contractor. These headers shall be so supported and shimmed that there shall be no movement thereof.

Where it is not feasible to use a mechanical spreader, the asphaltic concrete shall be spread with hot shovels and rakes. The hot mixture shall be dumped at such a distance from the mixture previously laid that all of the mixture must be turned and distributed into place with hot shovels. It shall then be raked in such a manner as to produce a surface of uniform texture, free from ridges, and have a uniform thickness.

Wearing surface mixture shall not be distributed from the hauling vehicles over a distance more than 30 feet in advance of the finishing machine.

Section 117

No wearing surface shall be spread when the atmospheric temperature is below 50° F., or during other unsuitable weather, or when the base is wet.

(f) Rolling.—Immediately after the wearing surface has been laid as above specified, it shall be compressed with power rollers, smooth running, and in first-class mechanical condition.

The minimum amount of equipment to be used in rolling wearing surface shall consist of three rollers, one of which shall weigh ten tons and have a center, or levelling, roller about 18 inches in diameter midway between the front and rear rollers, and the other two of which shall be tandem rollers weighing not less than eight tons each. The surface shall be rolled at the rate of not less than five hours for each 9000 square feet of pavement, and until the specific gravity of the compressed pavement is not less than 92% of the specific gravity of the combined aggregates. The rotation of equipment and the method and period of rolling shall be subject to the approval of the Engineer. Small areas inaccessible to rollers shall be compacted with hot tampers.

(g) Smoothness.—The finished surface of the pavement shall be true to grade and cross-section, free from elevations or depressions, and shall show a uniform distribution of aggregate. When a straight-edge ten feet long is laid on the finished surface parallel to the center line of the pavement, the surface shall in no place vary from the lower edge of the straightedge more than one-eighth of an inch.

(h) Conform Pavement.—Conform pavement shall consist of asphaltic concrete wearing surface, Type C, as specified in Section 117 and modified below. It shall be used as a variable thickness pavement course to adjust the surface of existing pavement to the surface of new pavement, or where shown on the plans or directed by the Engineer.

Conforms shall, where possible, be made along straight or regular lines carefully located so as to assure a smooth surface or proper crown.

Particular care shall be taken in the work adjacent to the conform line, where the conform pavement is to be less than 1-inch thick, as follows: The existing surface shall be well cleaned and the spray coat shall be properly applied. Hand irons shall be used to smooth the edge of the conform. These shall be kept very hot so as to soften the existing surface and insure a good bond between the new and old materials.

Conform pavement shall be paid for at the price bid per ton which shall include full compensation for all incidental work.

(i) Payment.—Except as otherwise provided above, or in the Special Provisions, no direct payment will be made for asphaltic concrete wearing surface, and the cost thereof shall be included in the price paid for the pavement, or other item, of which it is a part.

SECTION 118

ASPHALTIC CONCRETE BASE (BLACK BASE)

(a) **General.**—Asphaltic concrete base shall, unless otherwise specified, be 4 inches thick, and shall consist of:

(1) *Asphaltic cement* between 3.5 and 5 per cent by weight.

(2) *Mineral aggregate*, composed of coarse aggregate and sand, between 95 and 96.5 per cent by weight.

The asphaltic cement shall comply with the requirements of Section 31, and the sand and coarse aggregate shall comply with the requirements of Sections 23 and 24 respectively.

(b) **Grading and Proportions.**—The aggregate and asphaltic cement shall be mixed in the following proportions by weight, expressed as percentages of the total mixture including the asphalt.

Sieve Size	Percentage of Total Mix Retained on Each Sieve	
	Min.	Max.
1½"	0	—
1¼"	—	—
¾"	25	35
1/2"	—	—
1/4"	20	30
No. 10	5	15
No. 40	5	15
No. 80	5	15
No. 200	5	15
Passing No. 200	0	5
Asphaltic cement	3.5	5.0
Total	100	—

The exact proportions shall be subject to control by the Engineer, and may be varied within the limits set forth above.

(c) **Mixing.**—The mineral aggregates and asphaltic cement shall be prepared and mixed as specified in Section 117 of these specifications.

(d) **Subgrade.**—Before placing any of the asphaltic concrete mixture, the subgrade shall be prepared as provided in Section 101, except that in all cases where the area to be paved is composed of sand, or where a suitable unyielding support for the pavement cannot otherwise be provided, there shall be constructed a stable sub-pavement of waterbound macadam, six inches thick conforming to the provisions of Section 119, the subgrade for which shall be prepared as required by Section 101.

When, as in repaving over trenches, the area to be paved is too narrow to permit the use of a power roller as specified, thorough and equivalent compaction of the subgrade, and macadam if used, shall be

obtained by rolling with the wheels of a loaded truck of not less than five tons capacity.

(e) **Laying Base.**—The material shall be spread and rolled in accordance with the requirements of Section 117 (e), supplemented as follows: unless the specified thickness of the base after compression is less than 4 inches, the base shall be laid and rolled in two courses, each of which shall be laid and rolled in the manner specified for a single course. In restricted areas where the use of a power roller is impractical, compaction by means of a loaded truck, as specified for Subgrade, above, may be required.

No asphaltic concrete base shall be laid when the temperature is below 50° Fahrenheit, or in other unsuitable weather, or when the subgrade is wet.

(f) **Payment.**—Except as otherwise provided in the Special Provisions no direct payment will be made for asphaltic concrete base, and the cost thereof shall be included in the price paid for the pavement, or other item, of which it is a part.

SECTION 119

WATERBOUND MACADAM

(a) **General.**—Waterbound macadam shall be constructed of crushed rock or broken stone of such character that it can be compacted and tightly locked by watering and rolling, so as to make a stable, well keyed base or pavement. The compacted macadam shall be of the thickness shown on the plans or specified.

(b) **Crushed Rock.** The rock shall be free from all vegetable matter, loam, clay, or other deleterious substances. It shall all pass a screen having $2\frac{1}{2}$ -inch circular openings, and not more than 15 per cent shall pass a $\frac{1}{4}$ -inch screen. The material between the $\frac{1}{4}$ -inch and the $2\frac{1}{2}$ -inch sizes shall be uniformly graded from fine to coarse.

The rock shall have a "Percentage of Loss" of not more than 15, as determined by the Deval Abrasion Test made in accordance with the A.S.T.M. Standard Specifications, Designation D 2.

(c) **Screenings.**—When the crushed rock does not contain a sufficient amount of binder to bond properly under the action of watering and rolling, rock screenings shall be incorporated therewith.

The screenings shall be well graded from fine to coarse and at least 90 per cent shall pass a 3-mesh sieve. They shall be free from clay, loam, vegetable, or other deleterious matter, and shall have a cementing value of not less than 50.

When the screenings have been combined with the rock, the combined grading of the mixture shall be within the limits specified in Subdivision (b) above.

(d) **Subgrade.**—The subgrade shall be prepared in accordance with Section 101.

(e) Redwood Headers.—Header boards shall be furnished and installed as required by the provisions of Section 110.

(f) Laying Macadam.—Crushed rock shall be uniformly spread upon the subgrade to such a depth that after thorough compaction it shall have the form and dimensions shown on the plans or specified in the Special Provisions.

Where the thickness of the macadam is 4 inches or less, it shall be constructed in one course. If the required thickness is more than 4 inches, the macadam shall be constructed in not less than two courses.

Work on each course shall be handled in the same manner.

All rock shall be spread from self-propelled vehicles, or from spreader boxes. Dumping in piles on the subgrade will not be permitted. If, in handling, the rock segregates into sizes, it shall be remixed until it presents a uniform appearance.

(g) Rolling.—After the rock has been trued up to the proper cross-section, it shall be rolled with power rollers weighing not less than 350 pounds to a linear inch of tire. All rolling shall commence at outer edges and continue toward the center, but never from center toward the edges. The rolling shall continue until the rock does not creep or move in front of the roller. Should there be insufficient fines in the rock to obtain the above required results, screenings shall be added in the proper amount and broomed and rolled into the base.

Water shall be added in such amounts and at such times as may be necessary. The rolling shall continue until the macadam is thoroughly compacted and has a firm, even surface, true to grade and cross-section.

When the macadam is to be covered with asphaltic concrete wearing surface, a scratch template, as specified in Section 101, shall be provided and used to detect any high spots in the macadam. These shall be removed and the disturbed surface again watered and rolled until the surface is true to grade and cross-section.

(h) Preparation for Surfacing.—Before being surfaced with asphaltic concrete wearing surface, oiled surface, or emulsified asphalt, the water bound macadam shall be thoroughly broomed by hand or mechanical sweeper, or both. All dust, screenings, and other loose material shall be removed without disturbing the larger rocks in the macadam. The resulting surface shall be such as to provide a good mechanical bond with the surface course. If the macadam is not sufficiently compacted to withstand brooming, it shall be watered and rolled as specified above.

(i) Payment.—Waterbound macadam shall be paid for at the price bid per square foot, which price shall include the cost of subgrade, headers, and all other incidental work.

SECTION 120

OILED SURFACE FOR MACADAM

(a) **Preparation of Base.**—The macadam base which is to be surfaced shall be thoroughly broomed and cleaned as provided in Section 119 (h).

(b) **Crushed Rock or Gravel.**—Base rock shall be broken rock, crushed gravel, or both, and shall be hard, tough, durable, and sound. It shall all pass a screen having one-inch circular openings and be retained on a screen having $\frac{1}{2}$ -inch circular openings.

Screenings shall meet the requirements specified above for base rock, except that they shall all pass a screen having $\frac{1}{2}$ -inch circular openings and be retained on a screen having $\frac{1}{8}$ -inch circular openings.

(c) **Road Oil.**—Road oil shall be a liquid asphalt consisting of natural crude oils or residual oils from California crude asphaltic petroleum. Road oil shall conform to the following requirements when tested in accordance with the A.S.T.M. Standard Methods of Test of which the Designations are indicated:

	A.S.T.M.		
Asphaltic Residue of 80 penetration	D 243		95% min.
Flash Point	D 92		400° F. min.
Penetration of Residue after loss			
on heating at 325° F. for 5 hours	D 5	125	min.
Bitumen Soluble in Carbon Disulphide	D 4		99% min.

(d) **Application of Road Oil.**—After the base which is to be surfaced has been prepared as provided above, hot road oil, as above described shall be uniformly applied over the surface at the rate of $\frac{1}{4}$ gallon (measured cold) per square yard. The road oil shall be applied only when the air temperature is above 50° Fahrenheit, and shall have a temperature when spread of not less than 300° Fahrenheit nor more than 400° Fahrenheit.

Road oil shall be applied by means of a pressure distributor so designed and operated as to distribute under a pressure of not less than 25 pounds per square inch the amount required and at the temperature specified. It shall be equipped with a pressure gauge so located as to be easily observed by the Inspector while walking beside the machine. The distributor shall be so designed that any number of the sprayers may be closed to provide less than the normal width, thereby preventing overlapping of oil coating. In order to secure uniform distribution at the junction of two applications, the distribution shall be promptly stopped when the flow of road oil from the distributor begins to thin before the tank is empty. Before continuing the application of a new load of road oil, building paper shall be spread over the treated surface for a sufficient distance back so that the sprayers are operating at full force when the uncovered surface is reached. The building paper shall be removed and burned. A hose attachment shall be used to apply oil to spots unavoidably missed by

the distributor. No oil shall be distributed in cold, damp, or rainy weather, nor shall more oil be distributed than can be covered with screenings and rolled the same day.

(e) Application of Base Rock.—Immediately after the oil has been applied, the base rock, as above described, shall be uniformly distributed on the prepared subgrade. Base rock shall be applied at a rate of approximately 60 lbs. per square yard of surface.

Both base rock and screenings shall be distributed by approved spreading devices attached to rear of trucks. All trucks shall back up while distributing the rock or screenings so that the wheels of the truck will not come in contact with the hot oil. The surface of the base course shall be carefully trued up with a blade, brooms-drag, or other suitable equipment, and all high or low spots corrected by the addition or removal of rock. The surface shall then be rolled once over with a 5 or 6-ton roller—rolling progressing from side toward center.

(f) Second Application of Road Oil.—A second application of hot road oil shall be applied at the rate of $\frac{3}{8}$ -gallon per sq. yd., in the same manner as the first application.

The oil shall be immediately covered with fine screenings (20 to 25 pounds per sq. yd. required). The screenings shall be spread as specified above for base course. These screenings shall be rolled and broomed until the surface is smooth, uniform, and fully compacted.

(g) Maintenance of Oiled Surface.—The Contractor shall maintain the pavement until the date of acceptance, and if, at any time during the period between completion and acceptance, oil flushes to the surface in sufficient quantity to cause the pavement to become sticky, the Contractor shall immediately add sufficient screenings to absorb the excess oil. Any rolling of the surface shall be repaired at once by the Contractor. The above-described maintenance shall be done at the expense of the Contractor.

(h) Payment.—Oiled surface shall be paid for at the price bid per square foot which price shall include the cost of preparing the base, and all other incidental work.

SECTION 121

EMULSIFIED ASPHALT ARMOR COAT

(a) Materials.—Emulsified Asphalt.—The emulsified asphalt used shall be as specified in Section 30.

Crushed Rock.—The aggregates used shall be crushed gravel and shall be obtained from hard and tough boulder deposit, and shall be of such character that they will compact and lock thoroughly under rolling. They shall be asphalt preferential, and free from dust, clay, soft particles, vegetable or other harmful matter. At least 70 per cent of the coarse rock shall have fractured surfaces, and the aggregates shall be uniformly graded within the required limits.

The aggregates shall be of the following sizes as determined with circular openings for $\frac{3}{8}$ " and above, and with A.S.T.M. square openings below $\frac{3}{8}$ ". Not more than 10 per cent shall be coarser or finer, respectively, than the maximum sizes indicated.

Coarse Rock	1" to $\frac{1}{2}$ "
Key Rock	$\frac{3}{8}$ " to No. 10
Rock Chips	$\frac{1}{4}$ " to No. 10
Sand	$\frac{1}{4}$ " to No. 200

(b) Construction.—Before constructing the armor coat the macadam or base shall be thoroughly cleaned of all dirt and dust by brooming, and, if dry, shall be lightly sprinkled with water.

Headers will not be required unless otherwise provided in the Special Provisions or Plans.

All rock courses shall be distributed by means of approved spreading devices attached to the rear of trucks. All trucks shall back up while distributing the courses so that the wheels will not come in contact with the emulsion.

A tack coat of emulsified asphalt at the rate of 0.20 gallon per square yard shall be applied to the base, prepared as above specified, by means of a pressure distributor. The distributor shall operate under a pressure of not less than 20 pounds per square inch. The sprayers shall be so arranged that any number can be shut off so that different widths may be sprayed. The distributor shall be equipped with a hose attachment which shall be used to apply emulsion to spots missed by the distributor.

Coarse rock shall be immediately spread at the rate of about 55 pounds per square yard, while the tack coat is still brown. The rock shall then be carefully trued up with a blade, a broom drag not less than 7' x 12', or other suitable equipment, and all high or low spots corrected by the addition or removal of rock. The surfaces shall then be rolled once over with a power roller weighing not less than 6 tons. The rolling shall proceed from the sides to the center.

A second application of emulsified asphalt shall then be made at the rate of 0.30 gallon per square yard.

Key rock shall then be spread, while the emulsion is still brown, at the rate of about 20 pounds per square yard, and in sufficient quantity to fill the voids. The key rock shall then be broomed with the drag broom to get even distribution. The surface shall then be rolled, and broomed as required, until the key rock is forced into the voids of the coarse rock and until it is thoroughly locked and keyed. Surplus rock shall be removed by brooming.

A third application of emulsified asphalt shall then be made at the rate of 0.45 gallon per square yard.

Rock chips shall be immediately spread at the rate of about 12 pounds per square yard, and shall be broomed and rolled in the manner specified for key rock. The surface shall be rolled until it is smooth, uniform, and fully compacted.

A seal coat of emulsified asphalt shall be applied after not less than 24 hours. After any loose material remaining on the surface has

been removed by brooming, emulsified asphalt shall be applied at the rate of 0.25 gallon per square yard. Sand shall then be spread at the rate of about 7 pounds per square yard. Even distribution of the sand shall be obtained by brooming, and the surface shall be thoroughly rolled.

(c) Maintenance.—The Contractor shall maintain the armor coat until the date of acceptance. All holes or raveling developing during this period shall be repaired by the Contractor at his expense and when accepted the surface of the pavement shall present a smooth and uniform appearance.

(d) Payment.—Emulsified asphalt armor coat shall be paid for at the price bid per square foot, which price shall include the cost of preparing the base, and all other incidental work.

SECTION 122

MACADAM SIDEWALK

(a) General.—Macadam sidewalk shall consist of a base course of waterbound macadam covered with an emulsified asphalt surface.

(b) Macadam Base.—The waterbound macadam base shall be constructed in accordance with the requirements of Section 119, and shall be 4 inches thick when compacted. Redwood headers shall be provided as required by Section 110.

(c) Wearing Surface.—After the macadam base has been cleaned as required by Section 119 (h) it shall be lightly sprinkled with water. While the surface is still damp, emulsified asphalt in the amount of $\frac{1}{4}$ gallon per square yard, shall be applied with a pressure distributor as specified in Section 121 (b).

While the emulsion is still brown in color, fine gravel or screenings (10 mesh to $\frac{1}{4}$ -inch in size) shall be uniformly spread on the surface (approximately 12 lbs. per square yard) and rolled with a light power roller.

(d) Payment.—Macadam sidewalk shall be paid for at the price bid per square foot, which price shall include the cost of headers, waterbound macadam, asphaltic surface, and all incidental work.

PART IV
SEWERS AND DRAINAGE
SECTION 150
EXCAVATION

(a) General.—The Contractor shall make all excavations, and fills, necessary for the proper construction of the sewers and appurtenances, or other structures, included in the work.

Excavation shall be in open cut, unless otherwise provided in the Special Provisions.

Excavations and trenches shall be wide enough to allow adequate clearance inside the lagging and bracing for the proper construction, installation, and inspection, of the pipes and structures, but shall not exceed such necessary width.

Unless otherwise specified in the Special Provisions, all excavations and trenches below official street grade shall be maintained with vertical sides, and shall be no wider at the top than at the bottom, except as required to accommodate successive lifts of lagging.

Excavations and trenches shall be made safe and passable by the use of barricades, bridges, and other means in accordance with the requirements of Section 9 (p).

(b) Unsuitable Subgrade to be Replaced.—If the material in the bottom of the trench is rock, or is too hard to permit the forming of a proper and uniform bed for the pipe, the rock or hard material shall be excavated to a depth of at least four inches below the grade for the bottom of the pipe and replaced with sand compacted into place.

If the subgrade material does not afford a sufficiently solid foundation, it shall be excavated to such depth and width as may be necessary, and replaced with suitable material compacted into place. This work will be paid for under Force Account.

In conformity to Part II, Chapter X, Article 8, Section 373 (Ordinance No. 3540—Series of 1939) of the San Francisco Municipal Code there shall be no limitation on the use of labor-saving devices except at the locations, if any, specified in the Special Provisions, provided however that when, during construction operations, an additional location is revealed where, in the judgment of the Engineer, such limitation is necessary to avoid public nuisance or protect public health, safety or facilities, then such additional location shall be deemed to have been specified in the Special Provisions and the additional expense caused to the contractor by a limitation on his operations in such additional location shall be estimated and paid for as Extra Work in accordance with the provisions of Section 10 (b) of the Standard Specifications.

(c) Payment.—Unless otherwise specified in the Special Provisions, no direct payment will be made for excavation for sewers or drains, or for excavation for sewerage or drainage structures or appurtenances, and the cost of such excavation shall be included in the price bid for sewer or other appropriate item or items.

SECTION 151**SHEET PILING, LAGGING AND BRACING**

The Contractor shall furnish, install, and maintain such sheet piling, timbering, lagging and bracing, as is necessary to support the sides of excavations and any adjacent structures, and to prevent any movement of the ground or danger to life or property.

Should any sheet piling, timbering, lagging or bracing which has been installed appear to be in any way insufficient for its purpose, the Contractor shall at once provide additional and adequate materials. The provision of any additional supports ordered by the Engineer shall in no way relieve the Contractor of his responsibility for the sufficiency of his precautions.

All such piling, timbering, lagging, and bracing, shall, unless otherwise ordered, be removed during backfilling in such a manner as to prevent any movement of the ground. The vacancies left by such removal shall be immediately filled with sand or other fine material compacted into place by tamping or by saturation with water.

When the Engineer orders that sheet piling, lagging and bracing shall be left in place, such sheeting and lagging shall be cut off where directed and the upper part withdrawn.

No direct payment will be made for the work required in this Section, nor for any piling, lagging, or bracing, even though left in place.

SECTION 152**DISPOSAL OF SEEPAGE, STORM WATER AND SEWAGE**

The Contractor shall remove any seepage, storm water, or sewage that may be found or may accumulate in the excavation during the progress of the work. He shall furnish all necessary pumps and other appliances, and shall keep all excavations dry at all times during the construction of the work.

The Contractor shall use due vigilance and care so that no water originating on his work or due to his work or which he is obliged to handle and dispose of under the contract, shall discharge or be discharged upon the works or into the sewers or trenches of another contractor. Nothing in this section is to be construed as preventing the reasonable use by any contractor of any gutter or sewer which is designed and used for the sewage of the City.

The Contractor shall keep his completed work reasonably free from accumulations of water and sewage, and shall free it entirely at such times as may be required for inspection or other purposes.

The Contractor shall not construct a dam in any sewer without the written consent of the Engineer, and he will be responsible for any damage resulting from the construction of any dam or dams; and should the construction of said dam or dams cause sewage or storm

Section 153

water to back up and flow on private property through side sewers, or by other means, the Contractor shall immediately remove the dam or dams causing the back flow, and remove the sewage and storm water from the private property, and clean up and disinfect the premises.

SECTION 153

SUBDRAINS

Where ground water is encountered subdrains shall be constructed. These shall consist of vitrified clay pipe, of such diameter and under such portions of the work as may be necessary. The joints in the drain shall be either tight cemented or open as required. When the joints are open, the subdrain shall be surrounded with broken rock, and in addition if the drain is laid in running sand the joints shall be lightly packed with loose oakum.

Unless otherwise provided in the Special Provisions, no direct payment will be made for subdrains.

SECTION 154

REINFORCED CONCRETE SEWERS

AND SEWER STRUCTURES

(a) **General.**—Except as otherwise provided in this section, the construction of reinforced concrete sewers and sewer structures shall conform to the requirements of Section 205.

(b) **Materials.**—All materials shall conform to the requirements of Part I, Materials. Specific references are made as follows:

Material	Section
Concrete, shall be Class "B"	28
Cast Iron	41
Steel Wire Fabric	45 (i)
Common Brick	35
Vitrified Brick	36
Vitrified Clay Pipe	38
Mortar	27
Wrought Iron	44

(c) **Forms and Centers.**—Forms and centers may be made of either metal or timber. The surfaces of all timber forms that come in contact with the inside surfaces of concrete sewers and sewer structures, shall be made of T. & G. Douglas fir, laid with close joints and oiled with a non-staining mineral oil.

Forms shall be of sufficient strength, and so braced and supported, that they will maintain their shape and remain on the proper line and grade during the placing and vibrating of concrete.

(d) **Construction.**—The invert of the sewer or structure, up to the key joint, shall be constructed first. Forms, accurately held on line and grade, shall be used. The concrete shall be deposited in layers not more than 6 inches thick.

When a brick invert is specified, the brick shall be placed as soon as the concrete is sufficiently set, though not less than 24 hours after pouring. The brick shall be laid with the better surface exposed, in a full joint of mortar on bed, end, and side in one operation.

The bricks shall be laid as stretchers, and shall break joints with those of the adjoining courses. The courses shall be kept straight and parallel to the axis of the sewer, and at a true grade, by the use of a template. No traffic of any kind will be permitted on brick or other lining for at least 24 hours after placing.

When a brick invert is not specified, the concrete invert shall be finished as specified in the Special Provision or shown on the Plans.

Not less than 48 hours after the invert has been completed, the sides and top shall be constructed in the manner shown on the plans, and the concrete shall be deposited as above specified. No more wall and top section shall be started than can be completed the same day.

When the sewer or sewer structure is supported on piles, the walls and top shall not be poured till at least 7 days after pouring the invert.

Vertical construction joints with proper keyways shall be made at the end of each pour. Construction joints in invert and walls shall not be in the same plane, but shall be staggered.

After the completion of the walls and top, the forms and centers shall not be disturbed for 7 days.

Immediately after removal of the forms and centers, all rubbish and surplus materials shall be removed from the sewer or structure, in order to prevent any possibility of their entering the City's sewer system.

The interior surface of the sewer shall receive a coat of neat cement mortar applied with a brush. The sewer shall be kept free from sewage for 36 hours after the cement dressing has been applied.

(e) Curing.—Immediately after the sewer invert has been poured, it shall be covered with wet burlap and kept wet for a period of 7 days. The contractor may, after 24 hours, replace the burlap with straw, sawdust or earth kept thoroughly wet until the expiration of the 7-day period. The contractor may, after this 24-hour period, place the brick lining on the sewer invert, the bricks to be kept moist for the above mentioned 7-day period.

The concrete in the top and sides of the sewer or structure shall be cured by being kept continuously moist, either by sprinkling, wet burlap, or wet earth, for a period of 7 days, or the necessary curing may be accomplished by means of an impervious membrane as specified in Section 28 (e).

(f) Payment.—The length of reinforced concrete sewer to be paid for shall be measured horizontally along the center line of sewer between the limits of the sewer as constructed, and payment shall be at the price bid per linear foot.

Taper and other sewer structures shall be paid for at the lump sum prices bid.

SECTION 155

Y-BRANCHES AND STUB INLETS

(a) **General.**—Y-Branches shall be installed in all vitrified clay pipe sewers at 25-foot intervals on both sides, where necessary to provide connections for side sewers to the adjacent property.

Vitrified clay pipe stub inlets for side sewers shall similarly be installed in concrete sewers. V.C.P. stubs shall also be installed in concrete sewers, and in manholes on pipe sewers, where necessary to provide connections for present or future catchbasins and tributary sewers.

Y.branches and stub inlets shall be of vitrified clay pipe as specified in Section 38.

(b) **Y-Branches.**—The branch inlets shall be 6 inches in diameter in residential districts, and 8 inches in diameter in industrial and commercial districts. However, where necessary to accommodate any side sewer of a larger diameter, the inlet shall be of such larger diameter.

(c) **Stub Inlets.**—Stub inlets for side sewers shall be of the diameters specified above for Y-branch inlets. Stubs for culvert connections to catchbasins shall be 10 inches in diameter, and those for tributary sewers shall be of the diameters of such sewers.

Stub inlets shall be set with the back of the bell flush with the outside surface of the sewer or manhole, and shall be of such length that the inner spigot end shall be flush with the inside surface. They shall be securely fastened in the concrete forms so that they will not be displaced from their correct positions during placing of the concrete.

(d) **Y-Branches and Stubs to be Closed and Marked.**—The bells of all Y-branches and stub inlets not in service before the excavation is backfilled shall be closed with vitrified clay stoppers. The bell shall be covered with cheese cloth, so as to separate the bell from the mortar and stopper, after which the stopper shall be inserted and made watertight with cement mortar on the outside only. When the branches or stubs are to be left exposed the stoppers shall also be securely fastened in place with galvanized wire.

Each Y-branch and stub inlet to which no connection is made, except stub inlets in manholes, shall be marked by a 2" x 2" redwood stake running vertically from the bottom of the trench at the branch or stub to a point one foot below the surface of the street. Care shall be taken to maintain the stake in its correct position during backfilling. In addition to the redwood stake, the letter "Y" shall be stamped in the top of the curb opposite each "Y" branch from which a side sewer has not been constructed.

(e) **Payment.**—Unless otherwise provided in the proposal, or specified, no direct payment will be made for Y-branches or stub inlets, the cost of which shall be included in the price bid for sewers or manholes, or other appropriate item.

SECTION 156**CONNECTIONS WITH EXISTING SEWERS,
SIDE SEWERS, AND CULVERTS**

(a) **General.**—Where shown on the plans, required, or necessary, the work shall be connected with the existing sewers, sewer structures, side sewers, and culverts. Such connections shall be made in a workmanlike manner, and in the case of a connection to an existing reinforced concrete structure, the concrete shall be broken back so as to permit a proper overlap of new and old steel and to insure a good bond.

Where existing sewers, side sewers and catchbasin culverts are not at proper grade nor in good condition, such portion thereof as may be necessary to make a satisfactory and workmanlike connection with new work shall be removed and replaced with new pipe.

Where a pipe sewer is to be connected to the end of a brick or concrete sewer, the end of the brick or concrete sewer shall be closed with a brick wall not less than 8 inches thick, and a vitrified clay pipe of the required diameter shall be properly imbedded therein, to provide the necessary connection.

(b) **Payment.**—No direct payment will be made for the work required in this section, and the cost thereof shall be included by the bidder in the price bid for such item, or items, as he may think appropriate.

SECTION 157**VITRIFIED CLAY PIPE SEWERS**

(a) **General.**—Vitrified clay pipe (V.C.P.) shall be specified in Section 38.

Except as otherwise specified below, all pipe joints shall be made with Class "A" mortar, as specified in Section 27.

In all street crossings or intersections, "stub sewers" constructed for future connections shall extend one foot beyond the property lines extended.

(b) **Laying Pipe.**—Before being placed in the trench pipe shall be fitted together, matched, and marked in the positions that will give the truest possible invert line on the bottom of the interior of the pipes when laid. Such matching will not be required in the case of pipe less than 15 inches in diameter.

The pipe shall be laid uphill from structure to structure with the bell end up grade. Each pipe shall be laid, in the proper position determined as required above, on a firm bed, and shall have a uniform support and bearing for its entire length. Each bell shall be cleaned before the spigot of the succeeding pipe is inserted. A bell hole shall be dug at the end of each pipe to accommodate the bell and facilitate the making of the joint. The pipe must be laid in perfect conformity to the prescribed lines and grades, which must be obtained for each pipe

by measuring from a tightly stretched line running parallel with the grade and supported over the center line of the sewer by bars placed across the trench.

All adjustment of pipes to line and grade must be made by scraping away or filling in and tamping the earth under the body of the pipe, and not by blocking or wedging up. Any pipe which has been disturbed after the cement has set must be taken up, the joints cleaned, and the pipe relaid with fresh mortar.

(c) Pipe Joints.—In laying pipe 15 inches or more in diameter, the pipe shall be adjusted to grade and alignment, the spigot shall be pressed home in the bell of the preceding pipe, and a narrow gasket of oakum, dipped in neat cement grout, shall be firmly caulked into the joint, after which the joint shall be completely filled with mortar, pressed in by the hands protected by rubber gloves. The gasket shall be of sufficient length to reach entirely around the pipe, and of a thickness sufficient to bring the inverts of the pipe to the same level. Special care must be taken to properly fill with mortar the annular space at the bottom and sides, as well as at the top of the joints. After such space has been filled and the cement compacted, a neat finish shall be given to the joints by further application of similar mortar to the face of the hub so as to form a continuous and even beveled surface from the exterior of the hub to the exterior of the spigot. The cement covering of the joint shall, when required, be secured in place by the use of a strip of cheese cloth of suitable width.

In laying pipe less than 15 inches in diameter mortar joints shall be made as described above, except that gaskets may be omitted unless the pipe is laid below the water table, in which case gaskets shall be used.

The joints of all pipe 18 inches or more in diameter shall be carefully pointed on the inside, and those of pipes of lesser diameter shall be carefully wiped or scraped with a circular disk or swab. The greatest care shall be exercised to insure that no mortar is left in the interior of the pipe, and that all dirt is removed from the sewer as the work progresses.

Bituminous Poured Joints.—Where required in the Special Provisions or plans, or where the pipe is laid in a wet trench in which all parts of the joints are not kept free from water for 24 hours after being made, or where the pipe is laid in a trench in which there are live tree roots (within 25'), the joints shall be made with bituminous sewer joint compound as specified in Section 34.

The pipe shall be well centered with a gasket of loose, dry, unprepared oakum, jute, or other approved caulking material, so placed and caulked as to prevent any of the joint compound flowing through into the pipe. The clear space between the gasket and outer end of the bell shall be as follows:

6 inch pipe not less than $1\frac{3}{4}$ inches
8 inch pipe not less than $1\frac{3}{4}$ inches
10 inch pipe not less than $1\frac{3}{4}$ inches
12 inch pipe not less than 2 inches
15 inch pipe not less than 2 inches
18 inch pipe not less than $2\frac{1}{4}$ inches
21 inch pipe not less than $2\frac{1}{2}$ inches
24 inch pipe not less than $2\frac{3}{4}$ inches

In wet trenches the joint shall be poured as quickly as possible after caulking the gasket so as to prevent the gasket from swelling and filling a greater portion of the space than indicated above.

After the pipe has been properly placed and caulked, a runner shall be placed around the pipe and the ends of the runner clamped, leaving an opening at the top of the pipe sufficiently large to permit the material to be poured. The space shall then be completely filled with the joint compound.

The temperature of the material shall be not less than 250 degrees F. and shall be uniform throughout, so that it will readily flow to all parts of the annular space to be filled. The runner shall not be removed until at least 15 minutes after joint has been poured.

The kettle used for heating the compound shall have a capacity sufficient for several joints, and the vessel used for pouring shall contain enough of the liquid compound to complete a joint at one pour.

Alternate pipes may be poured outside the trench. When the pipe is $2\frac{1}{2}$ feet or less in length, not more than 3 lengths may be joined in one section.

When joints are poured outside of trench, a runner will not be required if the pipe is in a vertical position when joint is poured. When joints are poured in this manner the pipe shall not be disturbed for 30 minutes after pouring.

(d) Backfill.—After the joints have been made, and inspected and passed by the Inspector, but not before, the trench shall be back-filled as provided in Section 167.

(e) Measurement and Payment.—Vitrified clay pipe sewer shall be measured horizontally, from center to center of manholes on pipe sewers, or where the sewer does not terminate in a manhole it shall be measured to or from the end of the pipe as constructed, except that a pipe sewer terminating in a masonry or concrete sewer or structure shall be measured to or from the outside face of such sewer or structure. Payment shall be at the price bid per linear foot which shall include full compensation for excavation, backfill, repaving and all other incidental work.

SECTION 158
SIDE SEWERS

(a) General.—Side sewers shall be of Vitrified Clay Pipe, and, except as otherwise provided in this Section, shall comply with the requirements of Section 157 for vitrified clay pipe sewer. They shall be 6 inches in diameter in residential districts, and not less than 8 inches in diameter in industrial and commercial districts.

Side sewers shall be connected to the main sewer by means of V.C.P. Y-branches or stub inlets as indicated in Section 155, and shall extend to a point 12 inches beyond the curb line. In the case of Y-branches, the connection shall be made by means of $\frac{1}{8}$ V.C.P. bends.

(b) Grade and Depth.—Side sewers shall be laid on a straight grade from the main sewer to a point 12 inches beyond the curb line. This grade shall in no case be less than $\frac{1}{4}$ -inch per foot.

The upper end of each side sewer shall be at a depth sufficient to provide adequate sewerage for the property served. In no case shall the depth of the invert of a side sewer at the curb line be less than 4 feet below curb grade. In industrial and commercial districts this depth shall be 12 feet *where possible*.

(c) Ends of Side Sewers to be Closed and Marked.—The bell at the end of each side sewer not in service before the trench is backfilled shall be closed with a vitrified clay stopper as specified for Y-branches and stubs in Section 155 (d).

The end of each such side sewer shall be marked by a 2" x 2" redwood stake running vertically from the bottom of the trench to a point six inches below the surface of the walk or ground.

The end of such side sewer shall also be marked by the letter "S" placed on the top of the curb directly over the side sewer. In new concrete curbs the "S" shall be stamped in the fresh concrete. In the tops of other curbs it shall be neatly cut.

Before marking the "S" on the curb the Contractor shall verify the location of the side sewer by excavating to the top of the redwood stake. If for any reason the stake is not found, the Contractor shall excavate and expose the pipe. In no case shall probing with a bar, or other method, be permitted as a substitute for actual exposure of the stake or pipe.

(d) Side Sewer Trap—Where shown on the plans, side sewer vent traps shall be installed, complete with riser, frame, and cover. Any soil pipe or side sewer necessary in the sidewalk area shall also be constructed.

When a unit price for side sewer trap is included in the Proposal, but not otherwise, side sewer traps will be paid for at such unit price, which shall include full compensation for furnishing and installing trap, riser, frame and cover, trench excavation, backfill and all other incidental work. Side sewer or soil pipe in the sidewalk area will be paid for at the unit price bid for side sewer.

Where a new trap is not installed, but it is necessary due to change in grade to reset or replace the existing vent frame and cover, the Contractor shall make the necessary adjustment in the length of riser and set the frame and cover to grade, and the cost of this work shall be considered included in the price bid for sidewalk or other appropriate item.

(e) Measurement and Payment.—Side sewers constructed, as required above, shall be measured horizontally from a point 12 inches beyond the curb line to the centerline of main pipe sewers, or to the exterior face of masonry or concrete sewers, to which they are connected. Extensions or replacements of side sewers shall be measured horizontally between the limits thereof as constructed.

Side sewers shall be paid for at the price bid per linear foot which shall include full compensation for excavation, backfill, repaving, and all other incidental work, but not including trap, riser, frame and cover, which are covered in Subdivision (d), next above.

SECTION 159

V.C.P. CULVERTS

(a) General.—Vitrified clay pipe culverts shall comply with the requirements of Section 157 for vitrified clay pipe sewer. Unless otherwise provided they shall be 10 inches in diameter, and shall be laid on a grade of not less than 2 per cent.

(b) Measurement and Payment.—V.C.P. culverts shall be measured horizontally from the trap of the catchbasin to center of manhole, or where a culvert does not terminate in such structures it shall be measured to or from the end of the pipe as constructed, except that a culvert terminating in a masonry or concrete sewer or structure shall be measured to or from the outside face of such sewer or structure. Payment shall be at the price bid per linear foot which shall include full compensation for excavation, backfill, repaving, and all other incidental work.

SECTION 160

C.M.P. CULVERTS

(a) General.—The corrugated metal pipe for C.M.P. culverts shall be as specified in Section 40.

The pipe shall be carefully handled to prevent damage to the galvanizing, and shall in no case be dragged along the ground. Such damage will be sufficient cause for rejection of the pipe. If permitted by the Engineer, small areas, on which the galvanizing is damaged or destroyed, may be repaired by the application of two coats of hot asphaltic paint.

The pipe shall be laid in a trench excavated so as to fit the curve

Section 161

of the bottom of the pipe, and in accordance with the plans, or as directed. Backfilling shall be done with care so as not to distort the pipe or damage the pipe or galvanizing. Fine material free from stones shall be placed under and around the pipe and carefully tamped.

(b) Payment.—C.M.P. culverts shall be paid for at the price bid per linear foot which shall include full compensation for coupling bands, excavation, backfill, restoring pavement, and all other incidental work.

SECTION 161

TILE DRAINS

(a) General.—The drain tile for use in tile drains shall be as specified in Section 39, and of the diameter shown on the plans, or required in the Special Provisions.

Unless otherwise specified the trench for the drain shall be of a width not less than the outside diameter of the tile plus one foot, so as to permit at least 6 inches of rock backfill at each side of the tile.

The invert of each tile shall be laid true to line and grade, and the ends shall be laid as closely together as practicable. The tile shall be revolved until the ends fit closely together at the top. Junctions with branch lines shall be carefully and securely made. Strips of burlap or roofing paper, 6 inches wide and of a length equal to one-half of the circumference of the tile, shall be placed over the upper half of each joint and tied securely in place. The upstream end of drains shall be properly sealed or blocked to prevent removal of the soil.

The trenches shall be backfilled with rock to the required grade, or depth, in one-foot layers, each layer being thoroughly compacted. Unless otherwise specified, the rock backfill shall be crushed rock or gravel graded from $\frac{1}{2}$ " to $1\frac{1}{2}$ ".

(b) Payment.—Tile drains shall be paid for at the price bid per linear foot which shall include full compensation for excavation, backfill, restoring pavement, and all other incidental work.

SECTION 162

MANHOLES

(a) General.—Manholes shall be constructed of the type or types shown on the plans, and in accordance therewith.

V.C.P. stub inlets for present or future culvert and sewer connections shall be provided in each manhole as required in Section 155.

When a manhole is constructed in an improved street, or in a street which is to be improved under the contract, the manhole shall be constructed to conform to the improved street surface. In other cases, if the ground surface is below the official grade the manhole shall be constructed to conform to such official grade unless otherwise indicated on the plans; and if the ground surface is above the official

grade the manhole shall be so constructed that the internal diameter, at the proper elevation to conform to the official grade, is $24\frac{1}{2}$ inches, and shall be continued upward, with the same diameter, to conform to the ground surface.

All backfill at manholes shall be made with sand and shall be compacted by flooding.

(b) Brick Manholes.—Brick manholes, and any part of a manhole made of brick, shall be constructed with common bricks and Class “B” mortar, in accordance with Sections 35 and 27, respectively, except as otherwise specified below.

Excavations for brick manholes shall be sufficient to leave a clear space of not less than 6 inches between the brickwork and the side of the excavation or lagging, so as to give ample room for plastering.

Brickwork shall be constructed by skilled and careful bricklayers. The brick shall be well wetted before being laid, and every brick shall be laid in a full joint of mortar on bed, end and side in one operation. Every fifth course of brick shall be a header course. Care must be taken to break vertical joints. Horizontal mortar joints shall be as uniform as possible, and shall not exceed $\frac{3}{8}$ -inch in thickness. The bottom of the structure shall consist of a first course of brick laid flat and close on an even surface. This course shall be grouted with thin grout composed of equal parts cement and sand.

Subsequent courses shall be laid in mortar as above specified.

Particular care must be taken in forming the bottoms of the manholes along pipe sewers; they shall be built strictly in accordance with the plans, and must conform to the bottoms of the existing sewers. Brick channels shall be built of selected hard-burned bricks set on edge, laid in Class “C” mortar, and well bonded. The manhole floor and the channels shall be plastered with Class “C” mortar $\frac{1}{2}$ -inch thick, the channels being finished to a true and smooth circular section.

A bull’s eye with 1 rowlock course of brick shall be built into the manhole for each entering pipe.

The joints in the brickwork on the inside of the manhole shall be neatly struck, and the outside shall be plastered with Class “B” mortar at least $\frac{1}{2}$ -inch in thickness.

(c) Concrete Manholes.—Concrete manholes shall be built of Class “B” concrete, as specified in Section 28. Construction methods shall conform to the requirements of Section 205.

Forms of either steel or wood may be used. They shall be of correct shape and dimensions, substantially watertight, and of sufficient strength and so braced and supported that they shall maintain their proper shapes and position during the placing and vibrating of the concrete.

(d) Special Manholes.—Drop manholes and other special manholes shall be built as shown on the plans, and in accordance with the requirements of this Section.

Section 163

(e) **Manhole Frames and Covers.**—Cast iron manhole frames and covers shall be installed on all manholes as shown on the plans.

The castings shall comply with the requirements of Section 41, and shall have their weights indicated in white paint as specified therein.

The contact surfaces of frames and covers shall be machined as shown on the plans so that there will be perfect contact around the entire seat.

(f) **Manhole Steps.**—Manhole steps shall be installed in all manholes as shown on the plans. They shall be in accordance with the details shown on the plans, and shall be made of $\frac{3}{4}$ -inch round wrought iron which shall comply with the current A.S.T.M. Standard Specifications, Designation A-207. After fabrication each step shall be "hot dip" galvanized, in accordance with the current A.S.T.M. Standard Specifications, Designation A-123.

(g) **Payment.**—Manholes shall be paid for at the unit price bid which shall include full compensation for castings, steps, excavation, backfill, repaving, concrete foundation if used, drop connections, and all other incidental work.

The unit price bid for a manhole on a concrete sewer shall include all expense, due to such manhole, over and above the cost of a continuous sewer without such manhole.

No deduction on account of manholes will be made from the length of sewer to be paid for.

SECTION 163

LAMPHOLES

Lampholes shall be constructed in accordance with the design and details shown on the plans.

They shall be paid for at the unit price which shall include full compensation for excavation, concrete, T-branch, riser, frame and cover, backfill, repaving, and all other incidental work. No deduction will be made from the length of sewer to be paid for on account of lampholes.

SECTION 164

CATCHBASINS AND STORM WATER INLETS

(a) **General.**—Catchbasins and storm water inlets shall be constructed of the types shown on the plans and in accordance therewith. They shall be brick structures or concrete structures, as required by the plans.

All backfill at catchbasins and storm water inlets shall be made with sand and shall be compacted by flooding.

(b) **Brick Structures.**—Catchbasins and storm water inlets of

brick shall be constructed of common bricks and Class "B" mortar, and in accordance with the requirements for brick manholes in Section 162 (b), except as otherwise specified below. The entire inner surface of the brickwork shall be plastered with a smooth coat of Class "A" mortar which shall be at least 1-inch thick on the floor and $\frac{3}{8}$ -inch thick on the walls. In soft ground which is unsuitable for a brick foundation, the bottom of the structure shall be made of Class "B" concrete 9 inches thick.

(c) Concrete Structures.—Catchbasins and storm water inlets of concrete shall be constructed of Class "B" concrete, and shall be built in accordance with the plans.

(d) Curb Inlet.—Curb inlets shall be constructed as shown on the plans. Except as otherwise shown or specified, the construction shall comply with the requirements for concrete curbs.

(e) Multiple Curb Inlet.—Catchbasins with multiple curb inlet shall be constructed in accordance with these specifications and as shown on the plans. The number of inlets shall be as specified in the Special Provisions. When two inlets are specified, the center inlet shown on the standard plan shall be eliminated.

The concrete used shall be Class "B," and if the catchbasin is constructed of concrete, the inlet slabs and blocks may be poured monolithic with the catchbasin.

Brickwork shall comply with the requirements for brick manholes in Section 162 (b), except that the inside surface, instead of the outside surface, shall be plastered with Class "A" mortar.

When the inlets are built of brick the concrete blocks and slabs shall be precast.

The outer edge of the concrete slabs shall conform to the cross-section of the adjacent curb, and if the adjacent curb is stone curb or armored concrete curb, the edge of slabs shall be as shown on the standard plan with curb armor.

(f) Frames and Gratings.—Cast iron frames and gratings shall be installed on all catchbasins and storm water inlets as shown on the plans.

The castings shall comply with the requirements of Section 41, and shall have their weights indicated in white paint as specified therein.

Care shall be exercised to cast the contact surfaces in a true plane and free from irregularities. These surfaces shall be machined or ground if necessary to insure uniform contact between the grating and frame.

(g) Water Trap.—Water traps shall be furnished and installed in all catchbasins as shown on the plans.

(h) Payment.—Catchbasins and storm water inlets shall be paid for at the unit price bid which shall include full compensation for castings, trap, curb inlets, excavation, backfill, repaving, concrete foundation if used, and all other incidental work.

SECTION 165

MOVING AND RECONSTRUCTING CATCHBASIN

Under this heading existing catchbasins shall be moved and reconstructed in the new positions shown on the plans or specified. The catchbasins shall conform to the new, or reset, curbs.

Any damaged catchbasin or curb inlet shall be repaired or rebuilt so that the finished structure will comply with the requirements of Section 164.

Moving and Reconstructing Catchbasins shall be paid for at the unit price bid which shall include full compensation for excavation relocation, repair or reconstruction of the structure, backfill, and all other incidental work. Unless otherwise provided in the Special Provisions, the necessary culvert connection will be paid for at the unit price bid for culvert.

SECTION 166

ABANDONED SEWERS AND STRUCTURES

(a) **Abandoned Sewers.**—Existing sewers and appurtenances which have been abandoned, or are to be abandoned on account of the work under the contract, shall be removed to a depth of not less than 3 feet below street grade, or ground surface, or not less than 6 inches below subgrade for the sewers or appurtenances or other structures to be constructed under the contract when such abandoned sewers and appurtenances lie within the lines of the new sewers or structures.

The ends of pipe sewers and culverts not required to be removed shall be thoroughly sealed with brick and mortar or concrete. Other abandoned sewers and appurtenances not required to be removed shall be broken open, the contained sewage shall be removed, after which they shall be backfilled with sand thoroughly compacted by saturation.

(b) **Other Abandoned Structures.**—Disused or abandoned mains, ducts, or other structures, which may be found within the lines of the excavations necessary for the work, shall be removed unless they are one foot or more below the bottom of the required construction. The Contractor shall dig such test holes as may be necessary to determine the particulars and depth of any such structures. He shall notify the owner or utility concerned, if possible. On failure of such owner or utility to remove such disused structures, the Contractor shall remove the same to a depth of not less than one foot below the bottom of the required construction, and shall make all necessary backfill with approved material.

(c) **Payment.**—No direct payment will be made for the work required in this Section, and full compensation therefor shall be considered to be included in the payments made for sewers and appurtenances, or for other appropriate item or items.

SECTION 167

BACKFILLING

(a) **Backfill Around Structure.**—After the sewers and their appurtenances have been properly constructed and inspected, and after the mortar joints, plaster, and concrete have set sufficiently to prevent damage, fine earth, or sand, free from rock, shall be carefully deposited in the trench or excavation in layers not more than 6 inches deep, until the work is covered to a depth of at least 1 foot. The backfill shall be brought up uniformly on all sides, and care shall be exercised to avoid any possibility of disturbing the pipes or other structures. Each layer shall be thoroughly tamped, and moistened if necessary.

(b) **Backfill Over Structure.**—After completion of the backfill around the pipe, sewer, or structure, as above specified, and if the backfill material is sandy or granular, the remainder of the fill shall be made in lifts of not more than 10 feet. Each lift shall be thoroughly settled by flooding and the use of bars, or by jetting, or both.

If the backfill material is not granular, but is clay, or of such a nature that it will soften when saturated, and will not compact readily by the use of water, the remainder of the fill shall be made in layers not more than 6 inches deep. Each layer shall be thoroughly tamped using not less than one tamper for each two cubic yards of material compacted.

Where the ground along the line of the sewer is less than 3 feet above the top of the sewer, the sewer shall, unless otherwise provided in the Special Provisions or Plans, be covered with a fill of approved material to a depth of 3 feet above the sewer. The width of the top of the fill shall be equal to the width of the sewer and the side slopes shall be not steeper than $1\frac{1}{2}$ to 1.

Where the existing ground is below the subgrade elevation for the sewer or where, due to removal of existing sewers or structures, the bottom of the trench is below the elevation required for the new work, the necessary fill shall be made with sand compacted to the satisfaction of the Engineer.

(c) **Payment.**—No direct payment will be made for backfill, or fill as contemplated above, and the cost thereof shall be included in the price bid for the sewer or structure, or other appropriate item or items.

SECTION 168

RESTORING PAVEMENTS

(a) **General.**—When pavement, sidewalk, curb, or gutter, has been removed, destroyed, damaged, disturbed, undermined or displaced by the Contractor in prosecution of the work, the Contractor shall, in place thereof, construct the same type of pavement, sidewalk, curb, or gutter, in accordance with the requirements of these specifications, except that pavements having a macadam base shall be re-

Section 168

placed by a pavement consisting of a 2-inch asphaltic concrete wearing surface on a 6-inch Class "E" concrete base.

Before proceeding with the repaving, the edges of asphaltic pavement shall be trimmed back sufficiently to provide a clean, solid, vertical joint, and the edges of concrete base and concrete pavement shall be trimmed free of loose materials, wire brushed and washed with water.

The Contractor shall remove and replace such additional pavement outside the limits of the excavation or damaged pavement as may be necessary to insure a proper conform with the existing pavement, and to insure the construction of the new pavement along regular lines which shall be parallel to, or at right angles to, the street center line where possible.

Where curbs, gutters, and sidewalks are replaced, junctions with the existing improvement shall be made along straight lines, and in the case of sidewalk, the junction shall be made at the regular slab or rectangle markings.

All traffic buttons and lane and safety zone markers which have been removed or destroyed during the prosecution of the work shall be replaced by the Contractor.

If traffic is to be permitted to pass over any excavation after backfilling and before restoration of the pavement, then the Contractor shall furnish a satisfactory temporary plank, rolled rock, or macadam surface pending repaving.

(b) Payment.—No direct payment will be made for the work required by this section and full compensation therefor shall be considered to be included in the payments made for sewers and appurtenances, or for other appropriate items.

PART V
STRUCTURES AND MISCELLANEOUS
SECTION 200

CREOSOTING.. TIMBER AND PILES

(a) **General.**—Timber and timber piles, required in the Special Provisions to be creosoted, shall comply with the requirements of Sections 48 and 49, respectively, and shall be pressure treated with creosote as specified below in this section.

So far as practicable, all adzing, boring, chamfering, framing, gaining, mortising, surfacing, and the like, shall be done prior to treatment.

Unless permitted by the Special Provisions in the case of small quantities of materials, no creosoted material from stock will be accepted.

(b) **Pressure Treatment Processes.**—All creosoting shall be done in accordance with the current Standard Specifications for Preservative Treatment by Pressure Processes of the American Wood-Preservers Association, as modified or amended herein or in the Special Provisions.

Unless otherwise specified, the process to be used, and the minimum amounts of creosote retained in the wood, shall be as follows:

Material	Process	Min. Retention of Creosote, Lbs. Per Cu. Ft.
Piles.....	Full Cell.....	12
Timber in contact with ground or water:		
5" thick, or over.....	Full Cell.....	12
Less than 5" thick.....	Full Cell.....	14
Timber not in contact with ground or water:		
5" thick, or over.....	Empty Cell with initial air..	8
Less than 5" thick.....	Empty Cell with initial air..	10

(c) **Inspection.**—All timber which is to be creosoted shall be inspected, as provided in Section 48, before treatment. After treatment, all timber and piles shall be inspected by an inspector from a recognized testing laboratory, or inspection service, approved by the Engineer. Each piece shall be stamped by the inspector with a mark different from that used before treatment.

The Contractor shall furnish the City with the official inspection certificate of the laboratory or inspection service.

(d) **Preparation for Treatment.**—Timber and piles which are to be creosoted shall be air-seasoned, or seasoned by boiling under a vacuum, until all water which would interfere with the treatment process has been removed.

Before treatment all sawed timber 2 inches or more in thickness shall be incised on all four sides by means of a suitable power-driven

Section 200

machine with cutting teeth designed to give a uniform penetration and a regular pattern. The depths of incisions shall be as follows:

Thickness of Timber	Depth of Incision
6" and over.....	$\frac{3}{4}$ "
3" and under 6".....	$\frac{1}{2}$ "
2" and under 3".....	$\frac{1}{4}$ "

(e) **Creosote.**—The creosote used shall be in accordance with the current Standard Specifications of the A.S.T.M. for Creosote Designation D 390, or in accordance with the American Wood Preservers Association Standard Specification for Creosote Grade 1.

(f) **Penetration.**—The penetration of creosote in the wood at right angles to the surface shall be determined by means of borings, and shall be determined from the presence of black or dark oil. Light staining due to capillary action shall be ignored. After testing, the bored holes shall be filled with tight fitting treated plugs. Test borings in piles shall be made midway between the ends.

The penetration in piles shall not be less than $\frac{3}{4}$ ".

The penetrations in timber shall be not less than those which follow:

Size of Timber, Inches	Penetration, Inches
1 x 12 and 2 x 12.....	0.25
3 x 12.....	0.35
4 x 12.....	0.40
4 x 14.....	0.45
6 x 12.....	0.55
8 x 10.....	0.65
12 x 12.....	0.65
12 x 14.....	0.65

(g) **Handling.**—All creosoted lumber shall be carefully handled without sudden dropping, breaking of the outer fibers, bruising, or penetrating the surface with tools. It shall be handled with rope slings. Cant dogs, hooks, or pike poles shall not be used. All places where the surface of the treated timber is broken by cutting, boring, or otherwise, shall be thoroughly coated with hot creosote oil and then a coating of hot tar pitch. In handling creosoted piles, no tools or instruments which might in any way break or damage the surface shall be used, except within 3 feet of the ends of the piles.

(h) **Payment.**—No direct payment will be made for creosoting, full compensation for which shall be considered included in the unit or lump sum price, or prices, covering the treated timber or piles.

SECTION 201

GALVANIZING

Steel and iron required to be galvanized shall be fabricated into the largest practicable sections before galvanizing.

Structural steel shapes, plates, bars, and their products, which are required to be galvanized shall be hot-dip galvanized in accordance with the Standard Specifications of the A.S.T.M., Designation A-123, which provide for a zinc coating of not less than 1.8 oz. per square foot of actual surface in any individual specimen.

Hardware and small structural steel, or cast steel articles such as bolts, nuts, washers, and similar small articles, which are required to be galvanized shall be hot-dip galvanized in accordance with the Standard Specifications of the A.S.T.M., Designation A-153, which provide for zinc coatings ranging from not less than 0.80 oz. per square foot of surface in the case of nails, screws, and small bolts, to not less than 1.85 oz. in the case of rolled, pressed, and forged articles.

The galvanizing of other iron or steel products shall conform to the requirements of the appropriate Standard Specifications of the A.S.T.M.

SECTION 202

TIMBER STRUCTURES

(a) **Timber.**—Timber and lumber shall be the kind and grade specified in the Special Provisions or shown on the plans. Douglas Fir and Redwood shall conform to the requirements of Section 48, and shall be inspected as required by that Section.

(b) **Hardware.**—Bolts, nuts, dowels, lag screws, and drift pins shall be of steel conforming to the requirements of the Standard Specifications of the A.S.T.M., Designation A-7, except that steel made by the acid-bessemer process shall not be used.

Bolts shall have standard square heads and nuts, and full standard threads. They shall be of such length that there shall be between $\frac{1}{4}$ -inch and $\frac{1}{2}$ -inch projection beyond the nut after it is tightened up.

Drift pins shall be round and of the "head and point" type.

A washer shall be provided under each bolt head and nut bearing on wood. These washers shall be cast iron Ogee washers, unless malleable or plate washers are specified.

Standard nails of proper lengths and in ample numbers shall be used to make rigid connections where bolts or other fasteners are not specified.

All hardware, mentioned or contemplated above, shall be galvanized in accordance with the requirements of Section 201. All cutting of threads and shop work shall be done before galvanizing, and threads in nuts shall be re-tapped after galvanizing.

(c) **Construction.**—Lumber and timber shall be stored in piles on the site and adequately protected from the weather, unless it is to be used immediately. Untreated material shall be open stacked at least 12 inches above the ground. Creosoted material shall be close stacked and piled to prevent warping.

All lumber and timber shall be accurately cut and framed to a close fit, in such a manner that the joints will have even bearing over the entire contact surfaces. Mortises shall be true to size for their full depth, and tenons shall fit snugly. No shimming will be permitted in making joints, nor will open joints be allowed.

Holes for drift pins and dowels in untreated timber shall be bored with a bit 1/16-inch less in diameter than the pin or dowel to be used.

Holes for drift pins and dowels in treated timber, and holes for bolts in all timber, shall be bored with a bit of the same diameter as the pin, dowel, or bolt.

Holes for rods shall be bored with a bit 1/16-inch greater than the rod diameter.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the root of the thread.

If necessary to prevent splitting in small members, holes for boat or wire spikes shall be bored of a diameter equal to the least dimension of the spike.

All holes for bolts and drift pins, and all contact and bearing surfaces, shall be coated with white lead, asphalt, or hot creosote oil, as specified or directed.

All bolts shall be effectually checked after final tightening.

Countersinking shall be done whenever smooth faces are required. Horizontal recesses therefor, shall be painted with hot creosote oil, and, after the bolt or screw is in place, shall be filled with hot pitch.

(d) **Payment.**—Timber structures shall be paid for at the lump sum price bid, or at the price bid per thousand feet board measure (M.B.M.), and such lump sum or unit price shall include full compensation for all labor, lumber, timber, hardware, and other materials. Measurement of the quantity of lumber to be paid for at such unit price, shall be on the basis of nominal widths and thicknesses, and the actual lengths incorporated in the structure.

SECTION 203

PRECAST CONCRETE PILES

(a) **General.**—Precast concrete piles shall be constructed in accordance with the design shown on the plans. They shall be cast in a horizontal position.

The concrete used shall be Class "A" as specified in Section 28, except that 3 pounds of diatomaceous earth per sack of cement shall be used, and each batch of concrete shall be mixed for not less than 1½ minutes.

Reinforcing steel bars shall be as specified in Section 45. Wire for

spiral reinforcement shall comply with the Standard Specifications of the A.S.T.M. for Cold Drawn Steel Wire, Designation A-82.

Each pile as it is cast shall have the date stamped within 6 inches of the pile head. Square corners shall be chamfered.

(b) Casting.—The piles shall be cast in smooth mortar-tight forms rigidly made, and firmly supported so as to prevent any deformation during pouring or curing. The finished piles shall be so nearly straight that a line stretched from butt to tip shall not be more than 1-inch from the face of the pile at any point.

The concrete shall be poured in a continuous operation until the pile is complete, beginning at one end and working towards the other end. The form shall be kept as full as possible as pouring progresses, and the concrete shall be vibrated during placing to insure a dense concrete free from voids and honeycomb and having smooth even surfaces. The forms shall be slightly overfilled, the excess shall be carefully screeded off, and the surface shall be finished smooth.

If piles are cast in tiers, the tiers shall be separated by building paper.

(c) Curing.—Immediately after the initial set has taken place, the piles shall be covered with wet canvas or burlap, which shall remain in place for at least 24 hours. The wet canvas or burlap may then be removed. The piles shall be kept continuously wet by sprinkling for at least 10 days after initial set, and shall be allowed to harden for at least 30 days before being lifted or moved.

(d) Handling.—Removal of forms, storing, transporting and handling precast concrete piles shall be done in such a manner as to avoid excessive bending stresses, cracking, spalling or other injurious results. Piles damaged in handling shall be replaced.

The entire pile shall remain supported for at least 7 days, and shall not be subjected to any handling stress until the concrete has set for 30 days.

Where piles are to be loaded or stored in tiers, the blocking between the tiers shall be in vertical lines so that the weight of the upper piles will not produce bending in those of a lower tier.

(e) Payment.—Precast concrete piles shall be paid for as set forth in Section 204 (g).

SECTION 204

DRIVING PILES

(a) General.—All piles shall be driven with a single acting steam hammer, the ram or striking parts of which shall weigh not less than 5,000 pounds. The ram shall have a minimum stroke of 3 feet, and the hammer shall strike 60 blows a minute.

Timber piles shall be driven tip down. The butt end of the pile shall be protected from damage during driving, and should it become broomed it shall be reheaded.

The use of a follower will not be permitted.

All piles shall be accurately spaced, and shall be driven vertically, or on the batter shown on the plans, or as directed. Piles driven out of position shall be pulled and redriven. Piles seriously damaged in driving shall be removed and replaced with sound piles at the Contractor's expense.

Treated timber piles shall be carefully handled so that the creosote seal is not broken, and any pile which has had the creosote seal damaged shall be replaced at the Contractor's expense.

(b) Piles to be Driven to Refusal.—Unless otherwise specified or shown on the plans, all piles shall be driven to refusal. A pile shall be considered to be driven to refusal when further driving will injure the pile in the opinion of the Engineer, or when the average penetration does not exceed 1/10-inch per blow for the last ten blows struck, without rebound, on a practically sound pile head.

(c) Water Jets.—Water jets shall be used when sand or other resistant material is encountered before reaching the specified depth, or a depth sufficient for the support of the structure for which the piles are driven. The number of jets and the volume and pressure of the water at the nozzles shall be sufficient to freely erode the material adjacent to the pile.

The plant shall have sufficient capacity to maintain 100 pounds per square inch pressure at two $\frac{3}{4}$ -inch nozzles. A gauge shall be provided in the jet line so that the pressure may be determined at all times.

Before the required penetration is reached the jets shall be withdrawn, the final penetration being obtained with the hammer.

(d) Splices.—Splicing of piles will not be permitted except where the penetration is more than 100 feet below cut-off elevation, and then shall be done in strict accordance with the design shown on the plans, or as directed.

(e) Cut-Off.—Timber piles shall be cut off at the elevations indicated on the plans. Piles which are to be capped shall be accurately cut off so that a true bearing is obtained on each pile without the use of shims. Piles cut off otherwise shall be replaced. No shims will be allowed.

Timber piles driven so low that a sound cut-off cannot be made at the required elevation, shall be pulled and replaced with longer piles at the Contractor's expense. Other types of piles driven below the required elevation shall be spliced or built up as specified or directed.

(f) Treatment of Pile Heads.—The heads of all timber piles which are not under water shall be treated with 2 applications of a mixture of 60% creosote oil and 40% roofing pitch.

(g) Payment.—Timber piles shall be paid for at the price bid per linear foot, which shall include full compensation for furnishing, handling, driving, jetting, splicing, and cutting off piles, and for all

other incidental work. The quantity of timber piles to be paid for shall be the total length satisfactorily driven below cut-off, and no allowance will be paid for any portions of piles above cut-off.

Precast concrete piles shall be paid for at the price bid per linear foot which shall include full compensation for furnishing, handling, driving, jetting, splicing or building up, and cutting off piles, and for all other incidental work. The quantity of precast concrete piles to be paid for shall be the total length furnished by the Contractor, as required by the Specifications or ordered by the Engineer, and satisfactorily driven. Where it is impossible to drive a concrete pile to the required depth no deduction will be made from the pay quantity on account of the portion above cut-off. However, no allowance will be made for any extra length of pile poured by the Contractor in order to incase the ends of the reinforcement and thus facilitate driving.

Precast concrete piles furnished by the Contractor, as required by the Specifications or ordered by the Engineer, which are not required to be driven shall be paid for at their actual cost to the Contractor plus 15 per cent, and shall become the property of the City at the site of the work.

SECTION 205

CONCRETE STRUCTURES

(a) General.—Concrete sewers, sewerage structures, buildings, walls, stairways, and other concrete structures shall be constructed to the required lines and grades, and in accordance with the designs shown on the plans.

(b) Grading and Excavation.—The Contractor shall do all necessary grading in conformity with the requirements of Section 100. He shall make all necessary excavations in such directions, and of such widths and depths as will give suitable room for the proper construction of the required structure.

Excavation for the foundation of any structure shall extend to undisturbed ground or rock, the foundations being extended below the specified elevation where necessary to comply with this requirement. The last three inches of material excavated for foundations shall be loosened and removed with hand tools so as to leave an undisturbed bed.

Unnecessary excavation below foundations shall be backfilled to foundation grade by the Contractor with Class "D" concrete at his own expense. Excavations for pipes, conduits, and the like, below foundations shall also be backfilled with Class "D" concrete.

Where the bottom slope of the excavation for bearing structures or retaining walls is greater than 1 in 10 "step" footings shall be excavated at no additional cost to the City.

Existing loam and shrubs shall be removed and preserved pending backfill.

(c) **Tile Drains.**—Tile drains, backfilled with rock, shall be constructed behind all retaining walls even though not shown on the plans. The drain tile used shall be 6 inches in diameter and shall comply with the requirements of Section 39. The rock shall comply with the requirements of Section 24 as to quality, and shall be well graded in size from $\frac{3}{4}$ -inch to 3-inch.

Weepholes shall be provided through walls where shown on the plans, or required.

(d) **Backfill.**—As the work progresses, all vacant spaces which may be left in the excavations and all spaces which require filling to bring the surfaces to the elevations shown, shall be filled with sand, deposited in 2-foot horizontal layers and flooded with water until, after standing for 5 minutes, water will show on the surface, when another 2-foot layer of sand shall be added and flooded as before. If for any reason it is felt that the flooding method would in any way damage or affect the stability of the structure, the backfill shall be compacted by hand tamping as specified in Section 167.

Sewers and appurtenances shall be backfilled in accordance with the requirements of Section 167.

After backfilling, any loam and shrubs which were removed shall be replaced in the areas outside the structure.

(e) **Sheet Piling, Lagging, and Bracing.**—The Contractor shall furnish, put in place, and maintain such timbering, lagging, and bracing, etc. as will be required to support the sides of the excavation and prevent any movement which could in any way injure the work, or any other structure.

Whenever, at any point, sufficient or proper timbering, lagging, and bracing have not been provided, the Contractor shall, upon demand, provide additional timbering, lagging, and bracing at his own expense, and compliance with such demands shall not relieve or release the Contractor from his responsibility for the sufficiency of such timbering, lagging and bracing.

(f) **Disposal of Seepage and Storm Water.**—The Contractor shall remove any water or seepage which may be found, or which may accumulate, in the excavations during the progress of the work. He shall furnish all pumps and other appliances necessary therefor, and shall keep all excavations entirely free from water at all times during the construction of the work.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to avoid the possibility of any of the concrete materials being carried away.

(g) **Forms.**—Forms shall be constructed of sound material of correct shape and dimensions, shall be mortar tight, and of sufficient strength and so braced and tied together that the movement of men, equipment, materials, or placing and vibrating the concrete, shall not throw them out of line or position. They shall be so constructed that they may be easily removed without damage to the concrete.

Form supports shall be placed on adequate foundations and shall have sufficient strength and bracing to prevent settlement or distortion from the weight of concrete or other cause. Vertical post supports shall rest on double wedge shims by means of which the forms shall be maintained at the proper grade.

Except as otherwise specified, form sheathing shall be constructed of Douglas Fir, "C" grade, V.G. or F.G. Flooring. Sheathing inclosing a concrete surface which is to be plastered shall be Douglas Fir boards laid with close joints, substantially mortar tight, and with an unsurfaced side next to the concrete. Forms for hand rail, balustrades, and similar structures shall be metal or surfaced clear lumber. If lumber is used, the workmanship shall be the equivalent of first class pattern work, and shall be coated with a non-staining mineral oil.

When plywood is specified it shall be $\frac{5}{8}$ -inch, five ply, Douglas Fir Concrete Form Plywood, made with highly water resistant glue and treated with paraffin oil. On curved surfaces $\frac{1}{4}$ -inch, three ply, material may be used if properly backed up to prevent buckling.

Openings shall be left at the bottom of all forms where necessary to facilitate the clearing out of debris accumulated during their construction, and a cover piece provided with which to close same securely.

Ties.—Bolts, rods or other approved devices shall be used for internal ties. These ties shall be of such construction that when the forms are removed, no metal will be within $1\frac{1}{2}$ inches of the exposed concrete surface. Wire ties will not be permitted.

Plumbing and Leveling Forms.—Before the concrete is placed in any form the horizontal and vertical position of the form shall be carefully verified and all inaccuracies shall be corrected. All wedging and bracing shall be completed in advance of the depositing of concrete. During the pouring of the concrete, there shall be men assigned to keep watch on all forms and remedy any displacement or looseness of forms or reinforcement. No work shall be done on any form, nor shall it be moved in any way after concrete is in place, except to correct or secure it.

Wetting Forms.—Wood forms, other than plywood, shall be thoroughly water soaked with a hose and running water before placing any concrete. The wetting shall be started at least 12 hours before concreting. Forms shall not be soaped. A non-staining mineral oil may be used.

(h) Expansion Joints.—All walls, steps, copings, and other surface concrete structures shall have expansion joints as shown on the plans. If not shown on the plans, they shall be placed not more than 30 feet apart and shall be made with expansion joint filler, $\frac{1}{4}$ -inch thick, as specified in Section 33. Expansion joints shall also be placed at the junctions of steps with other structures, and at the top and bottom of any flights of steps, or wherever specified or shown on the plans.

(i) **Reinforcing Steel.**—Reinforcing steel shall comply with the requirements of Section 45, and shall be placed as set forth therein, and on the plans.

(j) **Concrete.**—The concrete used shall comply with the requirements of Section 28 and, unless otherwise specified, or shown on the plans, shall be of the class indicated in said section for the type of structure being built.

(k) **Rubble Concrete.**—Rubble concrete shall be used when specified, and shall consist of Class “D” concrete in which clean, sound, hard, well wetted boulders or rock may be incorporated. The boulders shall not exceed 30 per cent of the total volume. Boulders shall not exceed 14 inches in largest diameter, nor shall their maximum diameter exceed $\frac{1}{4}$ the width or thickness of the work in which they are placed. They shall be placed in fresh concrete so as to be partially embedded therein, and if necessary, raised and again placed to avoid entrained air and voids. They shall be spaced not closer than 6 inches in the clear to one another, horizontally or vertically, and not closer than 6 inches in the clear to any reinforcing rods or to the face of the work.

(l) **Placing Concrete.**—Before placing concrete, the forms will be thoroughly inspected, and all chips and dirt shall be removed, all temporary bracings and cleats taken out, all openings for pipes properly boxed, all forms properly secured in their correct positions and made tight, and all reinforcement secured in its proper place. Any steel which shows rust shall be satisfactorily cleaned.

All forms, while concrete is being poured therein, shall be completely detached from runways and mixer supports so that concrete in the process of setting shall be entirely free from any vibration whatever.

Any concrete which may be on the forms or reinforcement and is set and dry in advance of the completed work, shall be cleaned off and removed, and forms and reinforcing washed clean before fresh concrete is deposited.

Good runways, where necessary for concrete buggies, shall be provided to convey the concrete to place, in order not to displace the forms or reinforcement. Running buggies directly across reinforcing bars will not be permitted, and in no case will it be permitted to wheel buggies or walk on concrete within 12 hours after it has been deposited.

The concrete shall be conveyed to place in such a manner that there will be no separation of the different ingredients, and in cases where such separation inadvertently occurs or there has been a delay in depositing, the concrete shall be remixed before depositing. Care must be taken not to displace the reinforcement, anchor bolts or other fixtures that are to be imbedded in the concrete.

The concrete shall be thoroughly compacted by vibration during and immediately after deposition. The vibration shall be obtained by means of electrical or pneumatic internal vibrators having a frequency

of not less than 7,000 impulses per minute. The vibrator shall be inserted directly in the concrete for a period of from 20 to 30 seconds depending on the consistency of the concrete, and at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. The vibrator shall not be attached to either the reinforcing steel or the forms. The vibration shall be of sufficient duration to thoroughly compact the concrete, and to work it around the reinforcement and imbedded fixtures and into the corners and angles of forms, but shall not be continued so long as to cause segregation in the concrete. The Contractor shall provide a sufficient number of vibrators, operators, and helpers to properly compact each batch of concrete immediately after it is placed. It is contemplated that one vibrator will compact about 5 cubic yards per hour.

Vibration shall be supplemented by such spading as is necessary to insure smooth surfaces and dense concrete along form surfaces, and in corners and locations inaccessible to vibrators.

Concrete shall not be dropped through the reinforcing steel in such a manner as to cause segregation of the aggregates, resulting from repeatedly striking the reinforcing bars as the concrete falls. To prevent this segregation, vertical ducts or hoppers shall be used. In no case shall concrete be permitted to fall freely from a height greater than 5 feet.

The concrete shall be deposited in layers about 12 inches in thickness and, insofar as practicable, the work on each part of the structure shall be prosecuted in such a manner that the concrete in each layer is deposited before the concrete immediately under it has set.

When fresh concrete is placed upon or against concrete which is set, the entire surface of the set concrete shall be thoroughly cleaned, all laitance removed, washed with clean water, and then covered with a layer of liquid mortar composed of 1 part cement and 1 part of coarse graded sand, and the fresh concrete shall be thoroughly worked against the old work.

All construction joints in concrete work shall be located as directed by the City Engineer. In lieu of definite instructions to the contrary, these joints shall be located at points of minimum shear.

(m) Construction Joints.—Construction joints shall be so located and formed as to impair the strength and appearance of the concrete work as little as possible.

Before starting any concreting operation, the unit of pour shall be approved by the Engineer, and the entire unit so predetermined shall be completed during the concreting operation.

Construction joints shall be roughened, cleaned, and broomed with a layer of grout (1 part cement to 1 part sand) immediately before fresh concrete is placed against them.

All concrete in vertical members, such as columns and walls, shall be in place not less than 4 hours before any concrete is placed in the girders, beams or slabs directly over such columns or walls. Before placing is resumed, all excess water and fine materials which have

risen to the top shall be removed and the concrete shall be cut away, as may be necessary to insure a strong dense concrete at the joint.

(n) Removal of Forms.—No forms shall be removed from any concrete work until the concrete has set sufficiently so that the removal of the forms shall in no manner disturb the concrete or affect its strength.

Side forms for beams, girders, columns, railings or other members of the structure that do not resist dead load bending may be removed within 48 hours after pouring the concrete, if weather conditions are favorable. At times of low temperatures or other adverse weather conditions, the time may be increased to 5 days.

The false work and forms supporting concrete beams, slabs or other members subject to direct bending stress, shall not be removed or released in less than 21 days after concrete has been poured. Under adverse weather conditions this time may be increased to 28 days.

(o) Repairing Imperfect Concrete.—Voids or stone pockets discovered when the forms are removed shall not be pointed up until inspected by the Engineer.

All pockets of stone containing voids shall be entirely removed until solid concrete is reached. The edges of the concrete shall be cut away square and true, the concrete generously brushed with water, and the space completely filled with concrete or cement mortar, held in place with forms, if necessary. The color of the concrete or mortar used shall be carefully controlled so as to avoid any contrast with the adjoining work.

All poorly mixed or placed concrete found after the removal of the forms, and all concrete out of line or level shall be cut away and repaired or removed entirely and replaced, if replacement is necessary to obtain proper strength.

(p) Surface Finishes.—Particular care shall be exercised in vibrating and spading concrete at the surfaces of all concrete structures so as to force all coarse aggregate from the surface, and thoroughly work the mortar against the forms to produce a smooth finish, free from water and air pockets or honeycomb.

Ordinary Surface Finish.—Unless otherwise specified Ordinary Surface Finish shall be applied to all surfaces of concrete structures. It shall precede the application of the other finishes set forth below in all cases.

Immediately after the forms have been removed, the Contractor shall remove all form bolts or ties to a depth of at least $1\frac{1}{2}$ inches below the surface of the concrete. All holes and depressions, caused by the removal or setting back of the form bolts or ties, shall be cleaned and filled with Class "B" mortar. Care shall be exercised to obtain a perfect bond with the concrete, and to obtain the same color in the mortar as in the surrounding concrete. All fins caused by form joints and other projections shall be removed and all pockets cleaned and filled.

Class 1—Surface Finish.—After the completion of the ordinary surface finish, all surfaces shall be thoroughly rubbed with coarse carborundum stones. A mechanical finisher may be used for this purpose, in which case not less than 4 days shall elapse between the time the concrete is poured and the finishing is started. If the surface is rubbed by hand, a period of not less than 2 days will be required.

The object of this operation is to obtain a smooth surface of uniform texture and appearance, and to remove unsightly bulges or depressions, caused by form marks, or other imperfections. The character and quality of material used in form work and the care exercised in building forms will be a contributing factor in the amount of such rubbing required.

After the above process has been completed, the surface shall be washed with water to remove stains and free particles which adhere to the surface after rubbing.

Class 2—Surface Finish.—Where class 2 Surface Finish is specified, the ordinary surface finish and Class 1 surface finish shall be completed in succession. A thin cement mortar, consisting of one part Portland cement and one part fine sand (all passing 20-mesh sieve) to which has been added 5% by volume of calcium chloride, shall then be brushed on the surfaces as above prepared. When the cement film has set so that the sand particles or cement will not drag out of the surface pin holes, but before final set has taken place, the entire surface shall be thoroughly rubbed with fine carborundum stones (No. 25 to No. 30) until a smooth, even surface of uniform texture is obtained. No greater amount of mortar shall be applied in advance of rubbing than can be completely rubbed before final setting takes place. Immediately after the rubbing process, the finished surface shall be thoroughly washed with water.

This finish should be deferred until all other work which would in any way mar or affect the final finish is complete.

Class 3—Surface Finish, Gunite.—After the completion of the ordinary surface finish, the entire surface shall be thoroughly cleaned with water, or such other means as will leave a clean surface for bond between the concrete surface and the gunite. There shall then be applied a coating of gunite, not less than one-quarter inch in thickness, over the entire surface to be finished. The gunite shall be applied so as to present a smooth, even surface, free from irregularities of any kind. Immediately behind the guniting process, the surface shall be floated by means of a wood float until a satisfactory finish is obtained. The gunite shall be composed of one part cement to two parts of sand. The sand shall be as specified in Section 23.

Class 4—Surface Finish, Stucco Dash.—After the completion of the ordinary surface finish, all loose and clinging particles of concrete, or other materials, shall be removed, and the surface painted with a heavy cement wash just previous to applying the dash. The surface shall be wet but not thoroughly saturated at the time the dash is applied.

Mortar for the stucco dash finish shall be Class "B" as specified in Section 27. It shall be of such consistency that a surface of uniform appearance may be produced by successive applications of the dash.

The stucco dash shall be applied by means of a special dash brush, and care must be taken to prevent the sand and cement in the mixture from becoming segregated during the application. The work shall be done only by skilled workmen, and in a careful and workmanlike manner.

At least two coats, each approximately $\frac{1}{8}$ -inch thick, shall be applied, and the finished surface shall be kept damp for at least one week after application.

Waterproofing.—The backs of all retaining walls shall be waterproofed with two coats of hot asphalt, so as to prevent seepage except at weepholes which shall be provided as shown on the plans or directed.

(q) **Payment.**—Payment for concrete structures shall be made as provided in the Special Provisions.

SECTION 206

DRY RUBBLE WALLS

(a) **General.**—Dry rubble walls shall consist of stones meeting the requirements specified below, and shall be laid without mortar. They shall be constructed in conformity with the plans, or to the lines, grades, and dimensions specified.

(b) **Materials.**—The stones shall be sound and durable, and shall be free from structural defects, rounded, worn, or weathered surfaces, and from clay, earth, or other objectionable substances. No stone shall be used which has a minimum thickness of less than 5 inches and a minimum width of less than 12 inches, or which is less than one-half of one cubic foot in volume. In the base of the rubble wall, no stone shall be used which has a volume of less than one cubic foot. Small stones may be used for pinning and filling interstices in the heart of the wall.

(c) **Construction.**—All dry rubble masonry shall be constructed by experienced workmen. The stone shall be roughly dressed on beds and joints and laid on natural beds, being well bonded and breaking joints at least 6 inches. The wall need not be built in courses, but it shall be so constructed that no part is materially in advance of the other. Headers shall be distributed uniformly through the wall, so as to form approximately one-fifth of the exposed faces, and shall extend through the face of the wall and into the backing a distance at least equal to their thickness. Where a wall is less than 18 inches in thickness, the headers shall extend entirely through from front to back face. Where the wall is more than 18 inches thick, the headers shall either extend entirely through or overlap at least six inches. The interior of

walls shall be built up so as to leave no appreciable open spaces, and only sufficient spalls shall be used to wedge the large stones in place. No spalls should be used in the front of a wall, and the stones shall be so well bedded that none will be needed. This class of masonry shall be finished with a top course of coping, consisting of roughly-shaped stones not less than 6 inches thick, from 1½ to 4 feet long, and wide enough to cover the top of the wall, carefully laid in solid beds.

(d) Payment.—Dry rubble walls shall be paid for at the price bid per cubic yard, which shall include full compensation for all labor and material, for excavation and backfill, and for all other incidental work.

SECTION 207

MORTARED RUBBLE WALLS

Mortared rubble walls shall be constructed of the same grade of approved stones and in the same manner as Dry Rubble Walls, except that a bonding mortar shall be used between all stones, and all joints made full and struck neatly.

The mortar shall be Class "B" as specified in Section 27 of these Specifications.

Mortared rubble walls shall be paid for at the price bid per cubic yard, which shall include full compensation for all labor and material, for excavation and backfill and for all other incidental work.

SECTION 208

STEEL STRUCTURES

(a) General.—Unless otherwise specified or shown on the plans, the materials, workmanship, fabrication, and design of steel structures shall comply with the requirements of the current Standard Specifications for Highway Bridges, of the American Association of State Highway Officials.

(b) Storing Steelwork.—Steelwork to be stored shall be supported on suitable platforms above the ground. It shall be kept free from dirt, and shall be protected as far as practicable from corrosion. Care shall be exercised to prevent injury from deflection. Girders and beams shall be placed upright and shored, and long members shall be supported on an adequate number of skids.

(c) Materials.—Structural steel and steel for bolts shall comply with the Standard Specifications of the A.S.T.M., Designation A-7, except that steel made by the acid-bessemer process shall not be used.

Rivet steel shall comply with the Standard Specifications of the A.S.T.M., Designation A-141.

Steel for forgings shall comply with the Standard Specifications of the A.S.T.M., Designation A-18, for Class E.

Section 209

Steel castings for structural purposes shall comply with the Standard Specifications of the A.S.T.M., Designation A-148.

Iron castings shall comply with the Standard Specifications of the A.S.T.M., Designation A-48.

Malleable iron castings shall comply with the Standard Specifications of the A.S.T.M., Designation A-47, Grade No. 32,510.

Wrought iron plates shall comply with the Standard Specifications of the A.S.T.M., Designation A-42.

(d) Welding.—Structural steel shall not be welded unless specified, or shown on the plans, or with the written permission of the Engineer.

Welding shall be done in accordance with the current specifications of the American Welding Society for Welded Highway and Railway Bridges, or the current Specifications for Fusion Welding of the American Institute of Steel Construction.

(e) Payment.—Unless otherwise provided, steel structures shall be paid for at the price bid per pound, which shall include full compensation for all labor, materials, and equipment, falsework, painting, and all other incidental work not specifically covered by other items.

The weights to be paid for shall be determined, in the presence of the Engineer, on scales furnished by the Contractor.

SECTION 209

PAINTING

(a) General.—All paint shall be applied by brush unless otherwise specified or ordered by the Engineer. Surfaces which, in the opinion of the Engineer, are inaccessible to brushes, shall be painted by means of power spraying equipment which shall apply the paint in a fine even spray without the addition of any thinner.

All colors shall be selected by the Engineer, and the Contractor shall prepare necessary samples for inspection and approval.

The Contractor shall set aside a shed, room, or other satisfactory space in which to store and mix his materials. He shall provide suitable vessels in which all paint mixing shall be done. Care shall be exercised to eliminate the hazard of fire, and oily rags and waste shall not be allowed to accumulate, but shall be removed from the work each night.

The Contractor shall carefully protect the work from damage by paint spots, oil, and stains, and shall provide sufficient drop cloths to protect the work and other property from damage.

No exterior painting shall be done in rainy, damp, or frosty weather, nor until the surface is thoroughly dry. Where necessary, the Contractor shall take adequate steps to allay dust before painting. No painting shall be done on interior surfaces until all moisture, dirt, and dust, have been removed.

(b) Materials.—All unmixed materials shall be delivered on the work not less than one week before they are to be used so as to permit sampling and testing. They shall be delivered in unbroken packages, and shall be opened only in the presence of the Inspector. Any materials, not so opened, or any materials which do not conform to the specifications, will be rejected and shall be immediately removed from the work.

Red Lead.—Red lead shall comply with Standard Specifications of the A.S.T.M., Designation D-83. The true lead content shall be not less than 97 per cent.

Linseed Oil.—Raw linseed oil and boiled linseed oil shall comply with Standard Specifications of the A.S.T.M., Designations D-234 and D-260, respectively.

Turpentine.—Turpentine shall be either gum spirits of turpentine or steam distilled spirits of turpentine, and shall comply with the Standard Specifications of the A.S.T.M., Designation D-13.

Graphite.—Graphite pigment shall consist of finely ground graphite carbon and insoluble siliceous material. It shall be the natural amorphous material and shall contain from 35 to 45 per cent graphite carbon and not more than 5 per cent of calcium and magnesium carbonate and sulphate. The pigment shall be ground to a paste with raw linseed oil and delivered at the work in sealed packages.

Zinc Oxide.—Zinc oxide shall comply with the Standard Specifications of the A.S.T.M., Designation D-79.

White Lead.—White lead shall be basic carbonate white lead and shall comply with the Standard Specifications of the A.S.T.M., Designation D-81.

Drier.—Drier may be composed of lead, manganese, or cobalt, or a mixture of these elements combined with a suitable fatty oil, mineral spirits, or turpentine, or a mixture of these solvents, with or without resins or gums. All driers shall be of sufficient strength to give satisfactory drying qualities to the paint.

(c) Red Lead Paint.—Red lead paint shall be mixed in the following proportions:

Red Lead dry.....	20 pounds
Raw Linseed Oil.....	5 pints
Turpentine.....	½ pint
Drier	½ pint

If a second coat of red lead paint is required it shall be so colored as to be readily distinguished from the first coat.

(d) Graphite Paint.—Graphite paint shall be mixed in the following proportions:

Graphite Pigment.....	45% by weight
Red Lead.....	5% by weight
Raw Linseed Oil.....	50% by weight

To this shall be added sufficient Kauri Turpentine Japan Drier to produce satisfactory drying qualities.

(e) White Lead Paint.—White lead paint shall consist of 90 pounds of Lead and 10 pounds of Zinc, to which shall be added a sufficient quantity of Linseed Oil, Turpentine and Drier. One hundred pounds of White Lead and Zinc will make approximately 6 gallons of second-coat paint.

(f) Aluminum Paint.—Aluminum paint shall consist of aluminum pigment paste mixed in a “long oil varnish” vehicle, in the proportion of not less than 2 pounds of paste per gallon of vehicle.

The aluminum paste shall comply with the Standard Specifications of the A.S.T.M., Designation D-474.

The vehicle shall contain not less than 50 per cent by weight of non-volatile oils and gums, and shall pass a 60 per cent Kauri Reduction Test.

The paint shall set to touch in not less than 1-hour, nor more than 6 hours, and shall dry hard and tough in not more than 24 hours. The paint shall have good leafing qualities, shall show satisfactory brushing and leveling properties, and shall not break or sag when applied to a vertical, smooth, steel surface.

(g) Mixing Paint.—Paint mixed at the site of the work shall be mixed by experienced painters in suitable vessels. The paint shall be mixed only as wanted, and shall be kept well stirred.

Manufactured paint shall be mixed at the factory and no additions shall be made at the work.

(h) Preparation of Surfaces.—Before any painting is done the surface to be painted must be thoroughly clean and dry, and passed by the Inspector. Painting done without such approval, or paint which shows loose, checking, alligatoring, blisters, or holidays shall be scraped off and recoated before final coat is applied.

Metal surfaces shall be cleaned with steel scrapers, wire brushes or other approved means. No larger area of metal shall be cleaned in advance of painting than will permit of painting before rusting begins.

Before painting galvanized iron, all surfaces shall be brushed with a solution of 4 ounces of copper sulphate to one gallon of water, which shall stand for one hour and then be wiped off.

Where solder fluids have been used, metallic surfaces shall be thoroughly cleaned with lacquer thinner before any paint is applied.

All woodwork to receive stain or enamel finish shall be sandpapered before finish is applied, and further sandpapered between coats.

(i) Application.—All workmanship shall be of the highest grade. All materials shall be evenly spread and smoothly flowed on by brush

without runs or sagging. All brushes shall be of the best quality and all worn brushes shall be promptly removed from the work.

Brushes used for painting structural steel shall preferably be round or oval, but flat brushes not over 4 inches in width may be used.

(j) **Payment.**—Unless otherwise specified in the Special Provisions, no direct payment will be made for paints or painting, the cost of which shall be included in the appropriate lump sum or unit prices bid which cover the structure or material painted.

SECTION 210

TEST BORINGS

(a) **General.**—Test borings shall be made at the locations indicated on the plans or where directed by the Engineer.

The borings shall be made vertically, without the use of water, and unless otherwise specified, shall have a diameter of not less than 6 inches.

A well driller's auger and derrick, or other equipment satisfactory to the Engineer, shall be used for making borings unless otherwise specified.

(b) **Casings.**—Casings shall be furnished and installed by the Contractor through soft ground, or when specified. When perforated casing is required the area of perforations shall not be less than 5 per cent of the superficial area of casing. Perforations shall be slots, $\frac{1}{8}$ " wide.

Unless otherwise specified, all casings may be drawn and salvaged by the Contractor after completion of the work.

(c) **Boring Records.**—The Contractor shall furnish to the Engineer a log of each test hole, samples of each change of material encountered, and a sounding record of water depths and elevations in each hole. Logs shall be recorded on the standard forms which will be furnished by the Engineer on request.

Logs.—Logs shall show the class and description of material, thickness of each stratum, depth at which each stratum is encountered, whether material is wet or dry, ground water level or the level at which water enters or is lost, location and nature of obstructions that may be encountered and other pertinent information.

Samples.—Samples of each change in material encountered in hole shall be immediately placed in pint size, Mason jars and sealed with screw caps and rubber gaskets. These samples shall be delivered to the City Engineer's office within 24 hours from the time of removal from the test hole.

Section 210

Each sample bottle shall have a gummed label attached, on which shall be written the following information :

Date
Hole number, or other identification
Depth to top and bottom of stratum
Classification of material

In taking samples, care shall be exercised to make them truly representative of the material in the stratum sampled.

(d) Cleanup.—Upon completion of the work all test borings shall be solidly backfilled, unless otherwise specified or directed, and the Contractor shall promptly remove all of his equipment. He shall satisfactorily dispose of all refuse resulting from the work and leave the premises in a neat and clean condition.

(e) Payment.—Test borings shall be paid for at the price bid per linear foot, which shall include full compensation for furnishing complete boring records, and all incidental work of whatever nature.

Measurement of depth of hole shall be made by measuring the distances on the boring rods from the existing ground level to the point of the boring or drilling tool.

PART VI ELECTRICAL WORK

SECTION 250

SCOPE AND RULES AND REGULATIONS

In PART VI herein are set forth requirements for electrical work in connection with the lighting and traffic control of streets, bridges, underpasses, and subways, also requirements for electrical conduits, cables and appurtenances, for traffic signals and police telephone and fire alarm systems, and for other miscellaneous electrical work when relevant. The requirements of the other Parts of these Specifications shall be observed where applicable and not at variance with the requirements of Part VI.

Electrical material, construction, and installation shall comply with the National Electric Code, the Electrical Safety Orders of the Industrial Accident Commission of the State of California, the Electrical Code of the City and County of San Francisco, the Supplementary Rules and Regulations of the Department of Electricity of the City and County of San Francisco, and the General Orders of the Railroad Commission of the State of California.

SECTION 251

ELECTRICAL INSPECTION

The Contractor shall notify the Engineer at least 24 hours before beginning any electrical work, so that an inspector may be present during all electrical construction and installation. Such notice shall also be given before the resumption of electrical work after any discontinuance thereof.

Electrical work done in violation of this Section shall be subject to rejection.

SECTION 252

ELECTRICAL MATERIALS

(a) **Steel Conduits and Fittings.**—Steel conduits shall be new standard weight wrought steel conduit, either black enameled, or hot-dip galvanized, or sherardized, as specified, in accordance with the latest requirements of the National Electric Code for rigid conduit, and of a brand approved by the Engineer.

All exposed conduit and fittings, and conduit elbows used at lighting standard foundations and at traffic signal and stop sign foundations shall be hot-dip galvanized, or sherardized.

Conduits shall be free from internal obstructions or roughness, such as blisters, splits, splinters, fins, scale or rust.

All conduit fittings such as couplings, bushings, and locknuts,

shall be screwed fittings. Galvanized Erickson conduit couplings shall be used at points of union. Exposed conduit fittings shall be galvanized or sherardized.

(b) Asbestos-Cement and Fiber Conduits and Fittings.—When asbestos-cement, sometimes known and herein referred to as “transite” conduit or fittings are specified they shall be Johns-Manville Transite conduit or fittings, or approved equal.

Fiber conduits shall be Orangeburg “Nocrete” conduit, or approved equal.

All conduits shall be free from internal projections and rough or flaky areas that might injure the sheath of lead-covered cables during or following the installation.

Ends of each length of transite or fiber conduit shall be perpendicular to the sides and shall be so cut that no sharp edges may come in contact with the lead sheath of cables.

All fittings such as couplings, bends and bells, on transite conduit shall be made of transite, and those on fiber conduit shall be made of fiber.

(c) Primary Street Lighting Cable.—Unless otherwise specified or shown on the plans, primary street lighting cable shall be either No. 8 A.W.G., insulated for 5,000 volts, or No. 6 A.W.G., insulated for 1,500 volts, as required in the Special Provisions, and shall be single conductor solid copper, with 30 per cent Hevea Rubber, taped and covered with a lead sheath, all in accordance with the Tentative Specifications for Insulated Wire and Cable: Class AO, 30 Per Cent Hevea Rubber Compound, of the A.S.T.M., Designation D-27-39T, or subsequent revisions thereof.

All physical, chemical and electrical tests required to show compliance with the A.S.T.M. Specifications shall be made before shipment of the cable. The Contractor shall, before installing the cable, and as part of the cost thereof, furnish and deliver to the Engineer properly executed certificates covering each reel, showing that the cable meets the requirements of the specifications and giving the results of the tests made thereon. These certificates shall be issued by an approved electrical testing laboratory, or with the approval of the City Engineer, may be issued and certified to by the manufacturer of the cable.

Before any street lighting cable is installed samples thereof shall be delivered to the Bureau of Street and Public Building Lighting of the Public Utilities Commission for their approval. Samples shall be cut in presence of the City Engineer.

The cable shall be shipped on suitable stout reels. Both ends of each length of cable shall be hermetically sealed.

(d) Paint for Metal Lighting Standards.—The priming coat shall be duPont’s “Kromate” No. 67-710 or W. P. Fuller’s “Fultec” No. 4550, and the finishing coats shall be either duPont’s “Dulux” Olive Green No. 28-214, or W. P. Fuller’s “Fultec” Olive Green, or equals.

(e) **Concrete.**—Concrete for pullboxes, for junction boxes, and for foundations for electrical structures and equipment, shall be Class H, except where otherwise shown.

(f) **Miscellaneous Materials for Street Lighting.**—The following materials for use in street lighting construction shall be as indicated below, and of the brand or makes specified, or their equals.

Bonding Strap shall be General Cable Corporation No. 5 A.W.G. 36,000 C.M., $\frac{5}{8}$ " in width, tinned, soft annealed copper wire braided ground strap, or approved equal.

Cable Bonds shall be "STATITE."

Conduit Caps shall be standard malleable iron pipe caps.

Foundation Bolts shall be $\frac{3}{4}$ " or $\frac{7}{8}$ " as specified, 18" long, square head machine bolt with four inches of thread and a $\frac{1}{4}$ " x 4" square washer securely spot welded to the head. After assembly, bolt and washer shall be hot-dip galvanized. After galvanizing, the threads shall be cleaned of excess zinc. Each bolt shall be fitted with two hexagonal nuts and two washers, all galvanized.

Friction Tape shall be black MANSON.

Ground Clamps shall be Burndy "Groundem" type GH for $\frac{1}{2}$ " ground rod.

Grounding Bushings shall be T & B No. 3864, or approved equal.

Grounding Wedges shall be T & B No. 3654, or approved equal.

Ground Rods shall be $\frac{1}{2}$ " "Copper Clad" ground rod six feet long.

Insulating Varnish shall be No. 25 Ajax or M.I.C. No. 152.

Joint Compound shall be Ozite "A" as made by the General Cable Corporation.

Rubber Tape shall be OKONITE.

Screws for bonding and grounding shall be $\frac{1}{4}$ "-20 round head brass machine screws with $\frac{9}{32}$ " steel lock washers and brass nuts.

Soldering Paste shall be General Electric No. 293.

Varnished Cambric Tape shall be General Electric ten mil bias cut $\frac{3}{4}$ " No. 991.

Vertical Cable Supports shall be Kellems Grips-Cat. No. EB-3.

SECTION 253

INSTALLATION OF ELECTRICAL EQUIPMENT

(a) **Conduit, General.**—Except as otherwise provided below, all conduits in sidewalk areas shall be installed at a depth below the curb grade of not less than 18 inches, and not more than 36 inches.

All conduits in or across the roadway of any street, or other area paved or to be paved for the use of vehicular traffic, but not including driveways across sidewalks, shall be installed at a depth below the finished pavement grade of not less than 24 inches, and not more than 42 inches.

All street lighting conduit installed in sidewalk areas shall be laid within 12 inches of the curb line when the lighting standards are located at the curb, but when the standards are located behind the sidewalk then the conduit shall be installed along the back of the sidewalk.

All conduit shall be so installed that the cable will not be injured in pulling.

Where conduit changes direction, long radius sweeps shall be used instead of short bends, and in no case, except at foundations, shall a bend radius of less than 30 inches be used.

The bends at the foundations shall be of maximum possible radius but in no case less than 12 inches. Care shall be taken not to flatten the conduit in bending.

Conduits which terminate in the bases of lighting standards shall extend 2 inches above official curb grade and shall be threaded. All conduits entering the bases of lighting standards and pull boxes shall be fitted with conduit bushings or malleable iron caps, as shown on the plans or specified.

Where shown on the plans, the Contractor shall install spare conduit elbows in the foundations. The exact location of these elbows in the foundations will be determined in the field by the Engineer. Both ends of the elbows shall be capped.

The Contractor shall clean out all conduits after installation by pulling a mandrel or steel brush, approved by the Engineer, through each run. At all stages of the work everything possible shall be done to prevent foreign materials entering the conduit.

Conduit placed in basements under sidewalk shall be attached to the street retaining wall of the basement or shall be supported from the sidewalk structure immediately adjacent to the retaining wall. Such conduits shall be securely supported and fastened with conduit straps or galvanized hangers, spaced not less than 5 feet apart.

Galvanized or brass machine screws, not less than 5/16" in diameter, and expansion shields of approved type shall be used to fasten conduit straps and hangers to concrete and masonry structures.

After installation all accessible exposed surfaces of steel conduits in basements shall be painted with one heavy coat of white lead and linseed oil. All conduits in basements shall be identified with letters 1-

inch high stencilled in black paint at intervals of not more than 18 feet, as shown on the plans, specified, or directed.

Where a service connection is made at a manhole, vault, or hand-hole, the conduit shall pass through the wall and the opening around the conduit shall be neatly, carefully, and completely filled with Class B mortar. Where conduit passes through a basement wall the opening around the conduit shall be similarly sealed with mortar.

When laying conduit under existing pavement or sidewalk the Contractor shall determine for himself and entirely upon his own responsibility whether he shall lay the conduit in open trench or by opening sections of trench and pushing the conduit from one opening to the next without breaking the surface between openings. The pushing of the conduit shall be done with hand power jacks or other methods, approved by the Engineer, permitting a constant pressure to be applied. If jacking is employed, inspection holes shall be opened as requested by the Engineer to determine compliance with the requirements for depth and line. The Engineer may require the conduit to be laid in open trench, to secure satisfactory alignment, avoid damage to other structures, or for other reasons sufficient in his judgment.

(b) Conduit, Steel.—Conduits shall be cut with a hack-saw. Pipe cutters will not be allowed on the job. Both ends of every length and piece of conduit shall be carefully reamed open to the full diameter, removing all burrs and sharp edges. Threads shall be cut clean and true with sharp dies. No connections shall be made with defective threads. No pipe fittings, except caps shall be used. Erickson Conduit Couplings shall be used at each point of union. The ends of all conduit shall be securely screwed up and all joints shall be watertight. The threads on the conduit shall be well painted with white lead and oil before being screwed up. To avoid forcing it into the conduit when the joints are screwed up, no paint shall be applied to the interior threads of couplings or other fittings.

(c) Conduit, Asbestos-Cement and Fiber.—The joints in these conduits shall be made by means of "Harrington" type couplings. The joints in the asbestos cement conduit shall be made watertight by the use of Johns-Manville sealing compound or other approved asphalt-base compound. The compound shall be applied to the tapered end of the conduit and the coupling forced over it. Thus any excess compound is forced away from the open end of the joint instead of into it. No jointing compound shall be used for fiber conduits.

Ends of conduits shall be terminated at pull boxes with a standard transite or fiber end bell, and all open ends of conduits shall be provided with a suitable plug, or cap.

In installing transite or fiber conduit without concrete envelope, proper attention shall be given to the grading and leveling of trench bottoms and to the selection of backfill material. The trench bottom shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

After the conduits have been aligned, soft dirt, sand or other

fine fill shall be placed around the ducts and carefully and firmly tamped under, around and over them with hand tampers.

(d) Pullboxes and Junction Boxes.—Pullboxes and junction boxes shall be constructed where shown on the plans or directed. The conduits shall be brought into each box in such a manner that sufficient space is allowed for proper bonding of the conduits and so that the cable can be installed without damage.

Concrete shall be Class “H” as specified above.

After the cables have been installed and the necessary splices and bonding have been completed, all pullboxes and junction boxes shall be cleaned of dirt and the covers shall be permanently placed as shown on the plans.

(e) Lighting Standard Foundations.—Concrete foundations for lighting standards shall be constructed as shown on the plans.

Forms shall be constructed of sufficiently heavy material to be rigid; they shall be true to dimension, securely fastened, and extend the full depth of the foundation. Conduit bends and anchor bolts shall be securely mounted and held firmly in position by templates. Wooden forms and the bottom of the excavation shall be wetted before depositing concrete.

Concrete shall be Class “H” as specified above.

The concrete shall be spaded into the forms and shall be so tamped as to fill all corners and cavities and form a compact mass. Care must be taken that conduits and anchor bolts are not disturbed in placing concrete.

The top surface of the foundations shall be floated and finished to conform to the adjacent sidewalk, or at such other elevation as may be shown on the plans or required.

Where a lighting standard is to be installed above a sub-sidewalk basement the foundation therefor shall be of a design suitable for the particular situation and as approved or directed by the Engineer. Such foundations in sub-sidewalk basements, including necessary conduit elbows and anchor bolts, will be provided by the owner of the abutting property.

(f) Erection of Lighting Standards.—Standards shall not be erected on the concrete foundations until at least 5 days after placing concrete, and in no case until erection has been approved by the Engineer.

Each standard shall be mounted on the foundation bolts and shall be accurately plumbed and brought to grade, as shown on the plans. Nuts on the bolts shall be set up tight. Standards having a wire slot on the shaft and/or a door in the base shall be erected so that these will be located, as shown on the plans, or as directed by the Engineer.

After being plumbed upon its foundation, the inside of the tubular steel shaft of all standards having wire slots shall be filled up to the bottom of the wire slot with grout consisting of 1 part of cement and 4 parts of fine aggregate.

The base of standards having a cast iron base separate from the shaft, shall be set in place at the proper grade with the bottom at right angles to the axis of the pole. The side of the base next to the curb shall be parallel thereto. The space between the shaft and the top of the base shall be caulked with oakum and made watertight with steel sash putty.

The foundation inside the base of the metal standards shall be brought to sidewalk grade and shall pitch away from the shaft. The topping material shall be forced under the bottom of the base casting to give it a perfect bearing.

Metal standards having bracket arms shall be erected so that the arms are at right angles to the curb. The bracket arms shall be securely bolted in place so as to be square with the axis of the standard.

After concrete standards have been plumbed upon their foundation, the bottom of the base of each standard shall be given a complete uniform bearing on the foundation by grouting with cement mortar, consisting of one part cement and two parts of sand. The grout shall be thin enough to flow and shall be forced under the entire bearing surface of the base and shall completely cover the foundation bolts.

When a standard is erected in the sidewalk area where no concrete sidewalk exists, the Contractor shall construct one flag of concrete sidewalk around the base and to the proper sidewalk grade.

(g) Primary Street Lighting Cable.—Primary cable shall be drawn into the conduit and installed without injury to the lead sheath using only mineral grease as a lubricant. The use of animal or vegetable grease is expressly prohibited. The cable shall not be kinked or otherwise injured before or while drawing into the conduit or at any other time. The cable shall be continuous from standard to standard without splice. All damaged lengths of cable shall be immediately distinctively painted at point of damage and removed from the work.

Where two cables are to be installed in the same conduit, they shall be drawn into the conduit at the same time. Neither of the two cables shall be drawn into, or out of, the conduit separately.

When a cable is cut, both ends shall be closed or sealed by solder or tape, as directed, in such a manner as to prevent the entrance of moisture. Cut ends of the cable shall not be allowed to remain exposed to the air.

Where the primary cables connect to the terminals of a luminaire the ends of each section of cable shall extend up the pole and be connected to the terminals in such a manner as to form a continuous series circuit. The lead sheath shall be cut back, the tape shall be removed, and the exposed insulation shall be taped with two layers of varnished cambric tape, all as directed by the Engineer. The tape shall be painted with two coats of insulating varnish, allowing sufficient time between coats for the first to dry.

Where the cable connects to the primaries of the series transformers at the bases of the standards, connections shall be made with a wiped joint. The connections to the transformers may be made either before or after the erection of the standards, but in either case suffi-

cient slack shall be provided in the base to permit removing the transformers through the door in the base of the standards without injuring the splices.

If splices are needed, and authorized by the Engineer, they shall be made within the base of a standard or in a pullbox and shall be soldered, taped, and wiped, and the joint filled with "Ozite" as detailed on the plans. All cable joints shall be made in a careful and workmanlike manner by skilled mechanics.

No cable shall be pulled by an automobile or truck, but mechanical devices may be used for pulling if such devices are approved by the City Engineer.

Cables shall be pulled by means of approved cable grips or "wire baskets."

(h) Installation of Luminaires.—The upright luminaire shall be mounted by means of the bronze adapter furnished with it. The globe ring with socket, and auto-transformer, if specified, shall be fastened to the top casing of the standard so as to support the luminaire rigidly and plumb. Holes for these fastening screws shall be drilled and tapped in the field. All screws and fittings used in assembling and mounting the luminaire, including the adapter, shall be brass or bronze. All parts herein mentioned shall fit the top of the pole to the satisfaction of the Engineer.

The pendent luminaire shall be suspended by means of a standard pipe size brass nipple, as shown on the plans. The set screws in the luminaire and the brackets shall be adjusted and securely tightened so as to allow the luminaire to hang plumb and to prevent it from turning.

All sockets shall be adjusted to place the lamp filaments in proper position with respect to the reflectors and the glass globes. Adjustments shall be made in accordance with the intention of the designer and as recommended by the manufacturer.

All glassware shall be mounted and held firmly in position by the attachment devices, which shall be properly adjusted so that temperature changes in the glass will not develop undue stresses. All glass parts of the luminaires and lamps, shall, at the time of acceptance, be clean and free from paint.

(i) Relocation of Existing Traffic Signals, Fire Alarm and Police Telephone Boxes.—All labor and materials shall be furnished by the Contractor for this work, and shall be to the satisfaction of the Department of Electricity and in conformity with the Standards of that department on file in the shop of the Department of Electricity at 264 Golden Gate Avenue, which are hereby made a part of these specifications.

Before any existing unit is removed, a similar unit, furnished by the Department of Electricity, shall be hauled from the yard and erected by the Contractor in the new location, at least 48 hours before the existing signal is removed. It shall be set in a concrete base for that respective type of unit, as shown on the plans.

The existing unit must be removed and cleaned, and delivered to the Yard at 264 Golden Gate Avenue within 5 days after the replacement unit is obtained from the yard, the cost of which removal, delivery and haul of replacement unit shall be included in the bid price.

The Contractor shall not, in any case, disconnect, connect, or do any sort of work whatever on any cable of any of the herein mentioned units unless an authorized representative of the Department of Electricity be on hand to supervise and inspect the work.

That department must be notified at least 24 hours before any work is to be done so that a representative can be on hand to supervise the work.

The work will consist of furnishing all labor and materials incidental to the work, and shall include the setting of the new unit at the proposed location; the furnishing and installing of the connecting steel conduit, together with the necessary fittings, sleeves, etc.; the furnishing, installing, splicing, and connecting of the various types of cable; the construction and furnishing of the concrete foundations; and all other necessary work required to place the units in proper operation at their new locations.

Where cables have to be extended no splices will be allowed in the conduit, but new cable shall be installed.

The Department of Electricity will cooperate with the Contractor in obtaining the necessary cables, during delays in delivery.

(j) Relocation of Existing Electric Type Arterial Stop Signs.—All labor and material shall be furnished by the Contractor for this work and shall be to the satisfaction of the Department of Electricity and in conformity with the Standards of that department on file in the Shop of the Department of Electricity at 264 Golden Gate Avenue, which are hereby made a part of these specifications.

The Contractor shall not, in any case, disconnect, connect or do any sort of work whatever on any cable to a stop sign unless an authorized representative of the Department of Electricity be on hand to supervise or inspect the work.

That department must be notified 24 hours before any work is to be done so that a representative may be present.

(k) Relocation of City-Owned Lighting Standards.—All labor and material for this work shall be furnished by the Contractor. The work shall be done in accordance with the requirements for new installations. The complete unit shall be reset at the new location with conduits and cables completely connected and ready to be put in service.

Authority to start work on existing lighting standards or lighting circuits must be obtained by application to the City Engineer's Office at least 24 hours in advance.

Each lighting standard with its foundation may be moved as a unit, or a new foundation may be constructed, the existing foundation being broken up and disposed of by the Contractor.

New conduit and fittings shall be provided by the Contractor for extending the existing conduit to the new location of the Standard.

New cable shall be installed in each conduit run lengthened by the relocation. The existing cables that are removed shall be delivered by the Contractor to the Bureau of Streets and Public Building Lighting at the yard at 17th and Pond Streets.

(l) Pole Riser.—Where shown on the plans or directed, the Contractor shall furnish and install service conduit and cables to the Pacific Gas and Electric Company's pole. This service connection shall be installed in accordance with the Company's requirements.

The conduit riser shall be galvanized and shall extend up the pole at least ten feet above the ground line. The conduit above ground shall be fastened to the pole with single bolt galvanized iron pipe clamps and galvanized lag screws. Sufficient slack shall be left in the cable to extend up the pole and make the necessary connection to the source of supply. The necessary wood moulding, condulets, clamps, potheads, and other accessories, needed to complete the pole riser connection, will be furnished and installed by the P. G. and E. Co., at the expense of the Contractor. The amount of this expense shall be ascertained from said Company by the bidder, and shall be included by him in his bid price.

(m) Access to Public Utility Manholes and Vaults.—Neither the Contractor, his employees, nor any subcontractor shall enter, or do the work in or on any manhole, or vault of the Pacific Telephone and Telegraph Company, the Pacific Gas and Electric Company, the Public Utilities Commission of the City and County of San Francisco, or any other public utility until an authorized representative of the utility and/or the Department of Electricity shall appear on the work and instruct the Contractor where the conduit shall be brought into said vault. The utility company and/or the Department of Electricity shall be notified at least 24 hours in advance of any contemplated work of this kind.

A ladder shall be used to enter and leave the vaults and particular care shall be taken in preventing any damage to the plant therein. A suitable barricade shall be placed around all open manholes and a flagman shall be stationed at the site during the entire time the manhole cover is off.

No work of any sort shall be done in connecting or disconnecting cables unless a representative of the utility and/or the Department of Electricity shall be on hand to supervise the work.

(n) Bonding and Grounding.—All steel conduits, the sheaths of all cables entering each lighting standard and pullbox, and the shafts and bases of all metal standards shall be effectively bonded together with copper ground straps as shown on the plans. All surfaces to which bonds are fastened shall be cleaned before making the attachment. Attachment of bonds to the cable shall be made with "Statite" ground clamps using No. 12-24 R.H. brass machine screws and brass nuts. Where two or more bonding straps are spliced together, the joints shall be mechanically and electrically reliable through fastening with screws and soldering.

Steel conduits shall be connected to ground at points shown on the plans or directed and/or as specified, using ground rods driven 6 feet into the ground and tinned copper ground straps.

Transite and fiber conduits shall not be grounded.

(o) Painting.—Paints and painting of electrical equipment shall comply with the requirements of Section 209, except as otherwise shown or specified.

Metal lighting standards shall be furnished with a shop priming coat as specified. Contractor shall touch up the priming coat where defective or injured during transportation or installation, and shall allow paint to dry thoroughly. After installation each standard shall be painted with two finish brush coats in a workmanlike manner by journeyman painters.

The exposed bronze parts of the luminaire on the metal standards shall be given two finish coats brushed on after installation, or two spray coats and one field brush coat.

Care must be taken to protect sidewalks, glassware and parked automobiles, and other property, from splashes when paint is applied. Drop cloths shall be furnished and used by the Contractor where necessary. At the conclusion of painting all glassware shall be clean and free of paint.

(p) Excavation, Backfill, Restoring Pavements.—The Contractor shall make all excavations and fills necessary for the proper installation of conduits, foundations, and other electrical work. Care shall be exercised to avoid damage to existing improvements and adjacent property. Pavement shall not be broken by dropping a pile hammer or other heavy weight on it. Excavated material suitable for backfilling shall be piled where it will offer the least obstruction to traffic and the least interference with drainage. Excavated material not required for backfilling shall be removed within 24 hours. Excavations shall not be made until they are required for immediate use.

Excavations shall be backfilled with fine earth or sand, free from rock, which shall be thoroughly compacted by hand tamping and the use of water as necessary. If the excavated material is unsuitable, the Contractor shall furnish sand or other satisfactory material for backfilling. Attention is directed to Section 9 (x) under which the Contractor shall repair any pavement, curb, or sidewalk damaged by settlement during a period of one year from the date of acceptance.

All pavement, curbs, sidewalks, and other improvements, which are damaged or disturbed, shall be replaced by the Contractor. Attention is directed to Section 168, the requirements of which shall be strictly observed.

Pending repaving, the backfill or temporary pavement shall be sprinkled with water as necessary to prevent annoyance to the public from dust.

When the repair or restoration of any pavement, curb, sidewalk, or other improvement is unnecessarily delayed, the Engineer may order the Contractor to make such repair or restoration forthwith.

Upon failure of the Contractor to comply with such order within 48 hours, the work may be done by the City at the expense of the Contractor.

SECTION 254
ELECTRICAL TESTS

Primary street lighting circuits shall, after installation, be subjected to a high voltage test with a sixty cycle alternating current, having a crest voltage of 12,000 volts for 5,000 volt cable, and a crest voltage of 4,000 volts for 1,500 volt cable. The voltage shall be applied between the conductor of the circuit and the lead sheath for a period of five consecutive minutes, the two ends of the circuit being connected together and the sheath being grounded. Any faulty material or any defective part of the installation revealed by such test shall be replaced, or repaired by the Contractor in a manner satisfactory to the Engineer, and the same test shall be repeated until no fault appears. After such high voltage test has been satisfactorily completed, the installation shall be connected to the lines of the electric power system for a one-hour service test. Any material or part of the installation failing to function properly shall be replaced or repaired to the satisfaction of the City Engineer.

Electrical tests shall be carried out in the presence of the Engineer.

Satisfactory certificates of the high voltage tests shall be furnished to the Engineer by the Contractor.

PART VII
AUXILIARY WATER SUPPLY SYSTEM
FOR FIRE PROTECTION

CHAPTER I. GENERAL PROVISIONS

SECTION 300

SCOPE

In Part VII herein are set forth requirements for the construction and installation of additions, extensions, and alterations, in the Auxiliary Water Supply System for Fire Protection, and for the pipes, valves, hydrants and other appurtenances used therein.

The requirements and provisions of the other Parts of these Specifications shall be observed where applicable and not at variance with the requirements and provisions of Part VII.

SECTION 301

GENERAL REQUIREMENTS

(a) **Quality of Materials.**—All materials shall be of uniform quality and free from defects throughout their mass.

Castings shall conform to the shapes and dimensions shown on the plans and shall be made in such molds and with such cores as will render the castings clean, smooth and free from cooling strains.

The castings shall be true to patterns, sound, smooth and free from all flaws, defects or imperfections of any kind which, in the judgment of the Engineer, render them unfit for the use for which they are intended. All projections resulting from gates or risers shall be cut off and ground smooth with the surface of the casting.

No plugging or welding of defects will be permitted except with the approval of the Engineer.

(a) **Workmanship.**—The workmanship and finish of all materials shall be the equal in every respect of that of the best American shop practice.

All castings and other materials shall conform strictly to the required dimensions.

All surfaces worked with machine tools must be true and smooth and shall be finished to gauges, templates or jigs, so that all parts shall be absolutely interchangeable.

(c) **Castings to be Poured in Presence of Inspector.**—All castings, of pipe or other materials, made under the terms of these Specifications in San Francisco or elsewhere, shall be poured in the presence of the City's Inspector. The Contractor shall give the Engineer sufficient notice of the time and place of pouring so that arrangements may be made for an Inspector to be present.

(d) **Contractor to Furnish Test Specimens.**—The Contractor shall, at his own expense, furnish specimens of each material for testing by the Engineer. Test specimens shall be, in number, form, and dimensions, as required herein or by the Engineer, or as required by the appropriate A.S.T.M. Specifications, for such material, to which reference is made herein.

All specimens shall be poured, or cut off, in the presence of the Inspector. Test specimens will be machined and tested, by the City, at the City's expense.

(e) **Fire Department Jurisdiction.**—The existing Auxiliary Water Supply System for Fire Protection is under the jurisdiction of the Fire Department of the City.

The Contractor shall not operate any valve in, make any connection to, or otherwise interfere with, any part or appurtenance of the Auxiliary Water Supply System, except under the supervision and in the presence of a representative of the Fire Department.

The Contractor shall so conduct his operations that at no time shall more than two adjacent high pressure hydrants be out of service along the line of the work, unless authorized by the Fire Department.

SECTION 302

HANDLING OF MATERIALS

(a) **Maintenance Yard.**—The Maintenance Yard of the Auxiliary Water Supply System, in which are the Pipe Testing Plant and material storage facilities, is located at 2245 Jerrold Avenue. The Yard and material stored therein are under the jurisdiction of the Purchaser of Supplies, and the use or withdrawal of materials therefrom must be approved by the City Engineer or the San Francisco Fire Department.

Whenever the words "Maintenance Yard" are used in Part VII, they shall refer to the Maintenance Yard as described above.

The yard will be opened for receiving or delivering materials on week days, except Saturday, Sunday or Legal Holidays, between the hours of 8:00 A.M. and 12:00 Noon and from 1:00 P.M. to 5:00 P.M.

The Contractor shall notify the Engineer at least one day in advance as to the date and time he intends to deliver or withdraw materials or appliances from the Yard.

(b) **Materials Furnished by the City.**—Materials or appliances furnished by the City under the contract will be delivered to the Contractor at the Maintenance Yard, or at such other locations in the City as may suit its convenience.

All handling of materials, and all loading and unloading, shall be done by the Contractor at his own expense.

(c) **Contractor to Requisition Materials Furnished by City.**—Materials furnished by the City at the Maintenance Yard or elsewhere, will be issued only on requisitions approved by the Engineer.

Requisitions shall be issued and signed by the Contractor or his responsible representative.

The Contractor shall be responsible for the correctness of all requisitions, also for the correctness of all material accepted by him on these requisitions.

(d) Contractor's Responsibility for City Material.—The Contractor shall carefully inspect all materials and appliances delivered to him by the City and shall not accept any materials or appliances that are cracked, broken or defective in any way. The Contractor shall be responsible to the City in every way for any and all materials and appliances delivered to him by the City, and should any materials or appliances be damaged, in the judgment of the Engineer, after they are delivered to the Contractor, they shall be promptly replaced with new materials or appliances by the Contractor at his own expense. In case the Contractor should not promptly replace, or should refuse to replace, such damaged materials or appliances, they will be replaced by the City and the expense of such replacement will be deducted from any money that may be due, or that may become due, to the Contractor.

(e) Return of Materials to the Maintenance Yard.—All materials furnished by the City and delivered to the Contractor which are not used in the work shall be returned to the Maintenance Yard by the Contractor, at his own expense. The Contractor shall similarly return all salvaged materials, and also any materials furnished by the Contractor, as required by the contract, but not installed in the work.

Each consignment of such materials will be listed on an official form of receipt in quadruplicate. One copy will be retained by the Engineer in the field office. Upon proper delivery of the listed materials at the Maintenance Yard the other three copies of the receipt will be signed by the receiving clerk. One copy will be forwarded to the City Engineer's Office, one copy will be given to the Contractor, and one copy will be retained by the receiving clerk.

All materials returned or delivered to the Maintenance Yard shall be hauled, unloaded and stacked by the Contractor, at his own expense, where directed.

(f) Testing Pipe at Maintenance Yard.—In order to assist him, the Contractor may have, at his own risk, the free use of the pipe testing plant under the supervision of the Purchaser of Supplies or his representative every day except Saturdays, Sundays and legal holidays between the hours of 9 A.M. and 12 Noon and between the hours of 1 P.M. and 4 P.M., whenever during these periods the Pipe Testing Plant is not in use by other contractors. The Contractor shall, at his own expense, furnish the necessary labor and materials to test and handle the pipe through the testing plant.

The testing press will be put in a serviceable condition by the City and the Contractor shall be responsible for its upkeep during the time he uses it. The City will furnish necessary water and power for the testing plant.

SECTION 303

PATTERNS, TEMPLATES, GAUGES

(a) **City Owned Patterns.**—Patterns and parts of patterns for valves, hydrants, valve vault manhole castings, valve box castings, fire boat wharf manifolds, and many pipe line specials, and also templates, gauges, etc. for valves and hydrants, owned by the City, are stored under the jurisdiction of the Purchaser of Supplies in Corpora-Yard Shop No. 1, at 313 Francisco Street, and in the Bureau of Supplies Central Warehouse at 15th and Harrison Streets. The City does not guarantee the accuracy or completeness of these patterns, templates, gauges, etc., and prospective bidders are invited to inspect the same in order to determine their suitability for use in connection with the work.

(b) **Patterns Available to Contractor.**—Upon written application addressed to the Purchaser of Supplies, and approved by the Engineer or San Francisco Fire Department, the Contractor will be allowed the free use of the above patterns, etc.

Before using any of the City's patterns, etc., the Contractor shall check them with the drawings, and shall, at his own expense, make any necessary repairs, alterations or replacements of missing or defective parts in a workmanlike and permanent manner satisfactory to the Engineer.

(c) **Patterns Made by Contractor.**—Should it be necessary for the Contractor to make any patterns, templates or gauges, for materials to be used in the work, he shall make them in a workmanlike and permanent manner of wood, or other material satisfactory to the Engineer, and all such patterns, templates, and gauges shall become the property of the City after use by the Contractor.

(d) **Return and Delivery of Patterns to City.**—All patterns, templates, and gauges, both those borrowed from the City and those made by the Contractor shall be delivered by him upon completion of the work to the above-mentioned shop or warehouse as directed by the Engineer. All such patterns, etc., shall be delivered in perfect condition, and properly identified by marks and labels by the Contractor.

Before final payment, the Contractor shall deliver to the Engineer a written receipt issued by the Purchaser of Supplies upon satisfactory return and delivery of the above-mentioned patterns, templates and gauges.

PART VII
AUXILIARY WATER SUPPLY SYSTEM
FOR FIRE PROTECTION

CHAPTER II. MATERIALS

SECTION 310

CAST IRON PIPE

(a) **Drawings.**—Detail drawings showing the dimensions of the various sizes and classes of pipe are on file in the City Engineer's office.

The Contractor shall obtain from the Engineer any of these drawings which may be necessary to furnish the pipe included in the contract.

(b) **Cast Iron.**—The cast iron used in the manufacture of the pipe shall be gray iron remelted in a cupola or air furnace, without the admixture of cinder iron or any inferior metal.

It shall be of such character as to make a pipe tough, strong and of sound even grain, soft enough to satisfactorily admit of drilling, chipping and cutting, and capable of showing indentations from a sharp blow of a hammer without flaking.

Physical Properties and Tests.—The cast iron shall have a tensile strength of not less than 20,000 pounds per square inch, as shown by tests on specimens machined in accordance with the requirements for the Tension Test Specimen described in the current Standard Specifications of the A.S.T.M. for the Arbitration Test Bar and Tension Test Specimen for Cast Iron, Designation A124. Transverse Specimen bars of the metal 26 inches long by 2 inches wide and 1-inch thick when placed flatwise upon knife edge supports 24 inches apart, and loaded at the center shall support a quiescent load of not less than 2,000 pounds and show a deflection of not less than .32 of an inch before breaking.

The Contractor shall furnish specimens for tension and transverse tests as required by the Engineer. In default of definite instructions, at least 1 set of 4-test specimens of each of the kinds above designated shall be made from each heat or run of metal. These test specimens must be poured from the ladle either just before or just after a pipe is poured and must represent true samples of the iron used in the casting of the pipe.

The bars for testing the transverse strength or resilience of the metal shall be cast from regular patterns in dry or green sand molds as nearly as possible to the required dimensions. Proper corrections will be made in the results of the tests for slight variations in width and thickness.

In determining the suitability of the metal from said tests, the average of the three highest results obtained from each set of 4 bars will be considered as representing the actual strength of the iron.

The preparing of all test specimens shall be at the expense of the Contractor. The physical properties test, including necessary machining of specimens, and also the chemical analysis of all metal involved in the herein required pipe will be made by the City at no expense to the Contractor.

All lots of metals of which the samples do not meet the above requirements will be rejected by the City.

(c) Description of Pipe.—Pipe shall be made either with bell and spigot ends or with a spigot on each end, as shown on the plans or required.

The pipe shall accurately conform to the dimensions shown on the drawings. It shall be straight and shall be true circles in section, with its inner and outer surfaces concentric and shall be of the specified dimensions in outside diameter.

All pipe excepting that with a nominal inside diameter of 8 inches shall have a laying length of twelve feet.

The lengths of the pipe with a nominal inside diameter of 8 inches shall have a laying length of 4 feet, 8 feet or 12 feet, in such quantities as may be specified, or as required.

Class A and B pipe shall have the same outside diameter.

Class C and D pipe shall have the same outside diameter.

Class E and F pipe shall have the same outside diameter.

Class G and H pipe shall have the same outside diameter.

All pipes having the same outside diameter shall have the same inside diameter at both ends. The inside diameter of the lighter pipes of each standard outside diameter shall be gradually increased for a distance of about 6 inches from each end of the pipe so as to obtain the required standard thickness and weight for each size and class of pipe.

All bolting lugs shall be cast in such a manner that the bearing surface for bolts shall be true to the dimensions shown and at exactly right angles to the axis of the pipe.

(d) Lugs.—Lugs of the required form and dimensions shall be cast on such pipes as the Engineer may direct. The right is reserved, however, by the Engineer, to alter the dimensions of lugs from those shown on the drawings.

(e) Defective Spigots May be Cut Off.—Defective spigot ends on pipes 12 inches or more in diameter may be cut off in a lathe, and a half round wrought iron band shrunk into a groove cut into the end of the pipe and an additional groove shall be cut into the end of the pipe as shown on Drawing HPL-5151.52. Not more than 10 per cent of the total number of accepted pipes of each size of each class shall be cut and banded, and no pipe shall be cut and banded which is less than 11 feet in length exclusive of the bell unless lengths shorter than 11 feet are ordered by the City Engineer. In case the length of a pipe exclusive of bell differs from 12 feet, the standard weight of the pipe shall be modified in accordance therewith.

(f) Allowable Variations in Dimensions and Weight.

Gauges.—The thickness of the metal forming the pipe will be tested after the pipes have been freed from sand and cleaned. The Contractor shall furnish all the necessary tolerance gauges and any other gauges which may be required by the Inspector to check the pipe properly for conformity with the drawings and the allowable tolerances.

Diameter of Pipes and Sockets.—Special care shall be taken to have the bells and spigots of the required size. The bells and spigots will be tested by circular gauges, and no pipe will be accepted which is defective in joint room from any cause. The diameters of the sockets and the outside diameter of the spigot ends of the pipes shall not vary from the standard dimensions by more than 0.06 of an inch for pipe 16 inches or less in diameter, and 0.08 of an inch for pipes more than 16 inches in diameter.

Pipe Thickness.—For pipes whose standard thickness is less than 1 inch, the thickness of metal in the body of the pipe shall not be more than 0.08 of an inch less than the standard thickness, and for pipes whose standard thickness is 1 inch or more, the variation shall not exceed 0.10 of an inch, except that for spaces not exceeding 8 inches in length in any direction, variations from the standard thickness of 0.02 of an inch in excess of the allowance above given shall be permitted.

Weight.—No pipe shall be accepted the weight of which shall be less than the standard weight by more than 5 per cent for pipes 16 inches or less in diameter, and 4 per cent for pipes more than 16 inches in diameter.

When pipe is furnished under a unit bid price by weight, no excess of weight in any one pipe of more than 5 per cent of the standard weight for pipes 16 inches or less in diameter, or more than 4 per cent of the standard weight for pipes more than 16 inches in diameter will be paid for. Allowance will be made in the weights for variations from the standard weights as follows: the total weight to be paid for shall not exceed, for size and class of pipe received, the sum of standard weights of the same number of pieces of the given size and class by more than 2.5 per cent.

(g) Pipes to be Marked.—Every pipe shall have distinctly cast upon its outside surface in raised letters the year in which it was manufactured, the running number of the pipe of the same size and class, the initials of the maker's name, the initials of the name of the district in which it is to be installed, and the letters S.F. A.W.S.

These letters and figures shall be not less than 2 inches in length and 1/8-inch in relief, and shall be arranged as the City Engineer may designate, and in case any pipe shall be condemned, the letters S. F. A.W.S. and the serial number shall be erased by the Contractor under the directions of the inspector.

The running number of rejected pipes shall not be duplicated.

(h) Manufacture of Pipe.

Casting.—The pipe, excepting the 4-foot lengths with a nominal inside diameter of 8 inches, shall be cast in dry sand moulds in a vertical position with the bell end down. The 8" diameter pipe with the 4-foot lengths may be cast horizontal.

All castings shall be cast in such moulding sand or loam, and with such cores, as will render the castings clean, smooth and free from casting strains; they shall be true to pattern, sound and smooth, and without cold shuts, swells, lumps, scabs, sand holes, or defects of any nature which would unfit them for the use for which they are intended. No plugging or filling will be allowed.

The pipes shall not be stripped or taken from the pit while showing color of heat, but shall be left in the flask for a sufficient length of time, in the opinion of the Engineer, to prevent unequal contraction by subsequent exposure.

The pipes shall be removed from the pit in such order that those to be furnished under the contract shall be kept separate from and not mixed with other pipe.

Cleaning and Inspection.—All pipes shall be thoroughly cleaned inside and out, without the use of acid or any other liquid, and subjected to a careful hammer inspection. No casting shall be coated unless entirely clean and free from rust, and approved in these respects by the inspector immediately before being dipped.

Coating.—Every pipe shall be coated inside and out with coal-tar pitch-varnish. The varnish shall be made from coal-tar. To this material sufficient oil shall be added to make a smooth coating, tough, and tenacious when cold, and not brittle nor with any tendency to scale off, and of sufficient thickness so as not to scrape off in handling.

Each pipe shall be heated to a temperature of 300 degrees Fahrenheit, immediately before it is dipped, and shall possess not less than this temperature at the time it is put in the vat. The ovens in which the pipes are heated shall be so arranged that all portions of the pipes shall be heated to an even temperature. Each pipe shall remain in the bath at least 15 minutes.

The varnish shall be heated to a temperature of 300 degrees Fahrenheit and shall be maintained at this temperature during the time the pipe is immersed.

Fresh pitch and oil shall be added when necessary to keep the mixture at the proper consistency, and the vat shall be emptied of its contents and refilled with fresh pitch when deemed necessary by the inspector. After being coated, the pipe shall be carefully drained of the surplus varnish. When hardened, the coating shall be free from blisters and bubbles. Should it be necessary to recoat any pipe, it shall be first thoroughly scraped and cleaned.

Care shall be taken in handling the pipes not to injure the coating, and no pipes or other materials of any kind shall be placed in the pipes

during transportation or at any time after they have received the coating.

(i) Pipe to be Weighed.—After the coal-tar pitch varnish has hardened, the pipes shall be weighed at the foundry where they are manufactured under the supervision of the inspector, on correct scales, to be provided by the Contractor, said scales shall be tested with United States standard weights, to be provided by the Contractor whenever required by the inspector. The weight and class letter of each pipe shall be distinctly marked both on the inside and outside of the pipe with white paint.

When pipe is furnished under a bid price per unit of weight, the unit shall be a ton of 2,000 pounds.

(j) Hydrostatic Tests.

At Foundry.—When the coating has become hard, the pipes shall be subjected to a proof of hydrostatic pressure and shall also be subject to a hammer test while under this pressure.

The pressures to which the different classes of pipe shall be subjected are as follows:

Class	Hydrostatic Test Pressure
A	300 pounds per square inch
B	300 pounds per square inch
C	300 pounds per square inch
D	350 pounds per square inch
E	440 pounds per square inch
F	520 pounds per square inch
G	600 pounds per square inch
H	650 pounds per square inch

In San Francisco.—The Contractor shall further subject the pipes to a hydrostatic test similar to the above upon their arrival in San Francisco. Any pipes failing to meet the requirements of this test will be rejected, and the Contractor shall be required to furnish new pipe to replace them. If a pipe has been rejected for any cause, the serial number thereon shall be chipped off in the presence of the inspector, and this number shall not be used again on replacing pipe.

Pipe on which the coating has been damaged, or is defective shall be repainted in a satisfactory manner.

SECTION 311

GATE VALVES AND CHECK VALVES

(a) **General.**—All the valves covered by this Section are of the City's own special design.

The gate valves are of the following sizes: 8", 10", 12", 14", 16", and 18". The 12" and 14" gate valves shall be provided with 3" by-pass valves and head gearing. The 16" and 18" gate valves shall be provided with 4" by-pass valves and head gearing furnished for use in a horizontal or vertical position, as ordered.

(b) **Drawings and Samples.**—The Engineer will furnish to the Contractor drawings showing the details of all the valve parts, the kind of finish to be put on all surfaces, the limits of accuracy within which the work is to be performed, and all necessary shop directions. Samples of gate valves may be inspected at the Maintenance Yard.

(c) **Workmanship.**—All flanges and collars shall be provided with well rounded fillets.

All bolt holes shall be accurately drilled to templates or jigs, and spaced equally distant. The use of cored bolt holes will not be permitted.

No tap bolts or cap screws will be used where it is possible to fit bolts or studs.

All bolts and studs are to be fitted with cold pressed hexagon nuts.

All threads of all bolts and studs are to be cut with the greatest care and accuracy, and the nuts on all bolts and studs are to be tapped to fit the bolts neatly. Bolts and studs shall be of such lengths as to extend one thread through the nuts when the nuts are screwed home.

The surfaces against which nuts and bolt heads bear and the bearing surface of all nuts and bolt heads shall be faced to form true surfaces at right angles to the axis of the bolts.

The threads of all valve stems and seat rings shall be cut in a lathe.

No plugging, cementing or other stopping up of holes or flaws will be permitted.

No chaplets shall be used to support the cores of castings unless absolutely necessary, and then only with the consent and approval of the City Engineer.

On assembling the Gate Valves and Check Valves, and parts of Gate Valves, the threads of all bolts and studs shall be coated with graphite and oil immediately before screwing on the units.

(d) **Forged Steel Bands on Bells.**—When required, forged steel bands of the dimensions shown by dotted lines on the drawings shall be shrunk on the bell ends of certain of the various sizes of Gate Valves.

The bell ends of these Gate Valves shall be turned to the dimensions shown. The bands shall be lap-welded rings made from rolled steel of the quality hereinafter specified. Each band shall be bored out one-tenth of one per cent smaller in diameter than the bell end on

which it is to fit. All bands are to be uniformly heated until they have expanded sufficiently to permit of their being slipped into place, and, when in place, are to be allowed to cool gradually.

(e) Teeth of Gears.—The teeth of the gears and pinions for the gearing, through which the Gate Valves are to be opened and closed, shall be molded from cut metal patterns in the following manner:

A cut metal pattern shall be placed in a metal flask and molded with core sand. The flask shall then be placed in an oven and dried without removing the pattern. After the mold has been dried, the pattern shall be removed and the remainder of the process of making the casting completed in the usual manner.

(f) Packing Stuffing Boxes.—Before delivery, the stuffing box of each gate valve shall be properly packed with the material specified on the plans, and in a manner, satisfactory to the Engineer.

(g) Iron Castings.

Cast Iron.—Shall conform to the requirements of the current A.S.T.M. Standard Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Designation A-126, Class B.

Transverse and Tensile tests shall be made with standard test bars as specified under the above designated specifications.

Should the average result obtained from the best three out of four test bars of any heat or run of metal tested, fail to come up to the required standard, all castings made from that heat or run of metal shall be rejected.

Marking Castings.—The iron castings for all parts of Gate Valves, and of Check Valves, shall have numbers and figures indicating the diameter of the Valves of which they are a part, the running number of the casting of the same size and form, the initials of the maker's name, the year, and the letters S.F. A.W.S. cast on the outer side in raised letters of not less than 1 inch in length and one-eighth ($\frac{1}{8}$) of an inch in relief in such manner as the Engineer may direct; and in case any casting shall be rejected, the letters S.F. A.W.S. and the running number shall be erased by the Contractor under the direction of the inspector.

The running numbers shall in no case be duplicated and, in the event of the same running number appearing on two castings of the same size and form, the last casting to be made shall be rejected. The pattern number of each casting shall also be cast on each piece in letters $\frac{3}{4}$ " high by $\frac{1}{8}$ " in relief.

(h) Bronze Castings.

Chemical and Physical Properties.—A chemical analysis of each heat must show an alloy consisting of not less than 87 per cent nor more than 89 per cent of copper, not less than 9 per cent nor more than 11 per cent of tin and the rest zinc.

All castings made from a metal which the chemical analysis shows to contain more than one per cent of any other material or materials

will be rejected. The bronze shall have a tensile strength of not less than 35,000 pounds per square inch and a yield point of not less than 17,000 pounds per square inch and an elongation of not less than 20% in a test bar 2 inches long.

Tests and Test Specimens.—For determining the properties of bronze castings, the Contractor shall make specimen rods of a size and form suitable for the City's testing machine as required by the Engineer.

In default of definite instruction, at least one set of four rods shall be made to represent the quality of material in each lot of castings. These test specimens may be attached to the castings and cut off in the presence of the inspector, or they may be cast separately and stamped by the inspector immediately after casting.

In determining the suitability of the metal from said tests, the average of the three highest results obtained from each set of four rods will be considered as representing the actual strength of the metal. Should the average result obtained from the best three out of four rods fail to come up to the above requirements, all castings in that lot shall be rejected.

Quality.—All bronze castings shall be sound, clean, free from blow holes, porous places, cracks or any other defects which affect their strength or appearance or indicate an inferior quality of metal. The color of the fracture where the gates are broken off castings must, in each instance, be uniform throughout, of a fine crystalline grain and without any signs of segregation of the materials of which the alloy is composed.

Marking Castings.—All bronze castings shall have the letters S.F. A.W.S. cast on them in raised letters, and in case any casting shall be rejected, the letters S.F. A.W.S. shall be erased by the Contractor under the direction of the Inspector, or, if the Contractor considers it more advantageous to himself, the letters S.F. A.W.S. need not be cast on bronze castings, provided, that any bronze castings, which shall be rejected, shall be immediately broken up in the presence of the Inspector. The pattern or part number of each piece shall also be cast on each piece.

(i) Tobin Bronze.—Tobin Bronze, rolled or cast and hammered shall be homogeneous and uniform in character throughout. It shall have a tensile strength of not less than 60,000 pounds per square inch, a yield point of not less than $\frac{1}{2}$ of the ultimate tensile strength and an elongation of not less than 25% in a test bar 2" long. The fracture shall exhibit a fine crystalline grain of uniform quality throughout without any signs of segregation of the metals of which the alloy is composed.

Rolled or cast and hammered Tobin Bronze rods will be tested in lots of 200 pounds or less. The Contractor shall furnish test specimens from each lot as required by the Engineer.

If the results of any test fall below the above requirements, the

rod from which the test piece was taken shall be rejected and test pieces from two other rods of the same lot will be tested. Both of these test pieces must successfully withstand the required tests or the entire lot which they represent will be rejected

(j) **Wrought Iron.**—Wrought Iron shall conform to the requirements of the current Standard Specifications of the A.S.T.M. for single and double Refined Wrought Iron Bars, Designation A-189.

(k) **Steel.**

Bolts, Studs.—Steel for bolts and studs, except as otherwise specified, shall conform to the requirements for bolts of the current Standard Specifications of the A.S.T.M. for Steel for Bridges and Buildings, Designation A7, and shall have a carbon content of not more than 0.18 per cent, in order to insure its suitability for heading and threading.

Forged Steel, Forged Machine Steel.—Forged Steel and Forged Machine Steel shall be within the requirements of the current Standard Specifications of the A.S.T.M. for Carbon Steel and Alloy-Steel Forgings, Classes B to M, Designation A-18.

Cold Rolled Steel.—Cold Rolled Steel shall conform to the requirements of the current Standard Specifications of the A.S.T.M. for Commercial Cold Finished Bar Steels and Cold Finished Shafting, Designation A-108.

(l) **Marking Valve Parts.**—Each individual part of the valves shall be marked with the Pattern and Part Number, as indicated on the drawings, the serial number of each casting or individual piece of the same type or form, and with such other figures or letters as are herein specified.

On those parts of the valves, on which it is impracticable or undesirable to cast the designated letters and figures, such letters and figures shall be stamped in a satisfactory manner.

(m) **Valve Tests.**—Each valve shall be subjected to the following tests at the shop and all Valves which fail to pass the required tests satisfactorily will be rejected. All tests shall be under the direction of the Engineer.

Test No. 1.—Before being painted the Gate and Check Valve bodies and bonnets shall be subjected to a cold water pressure of 650 pounds per square inch without showing any leakage, sweating of the material or other defects.

Test No. 2.—After assembly, each Gate Valve shall be tested as follows: The tightness of the joint between the face of the disc and its seat shall be tested by closing the gate, leaving one end of the valve open to the atmosphere and applying a cold water pressure of 650 pounds per square inch to the other side of the valve. The Gate Valve shall not show leakage in excess of one fluid ounce per minute, sweat-

ing of the metal, or any other defect. The operation will then be reversed and the valve and the valve seat on the opposite side of the disc tested in the same manner.

The Check Valves shall be tested for the tightness of the joint between the face of the flap disc and its seat, by applying a water pressure against the flapper of 650 pounds per square inch, the other end of the valve being open to the air. The Check Valve shall not show leakage in excess of one fluid ounce per minute, sweating of the metal, or any other defect.

The necessary tools, appliances, labor and materials for making the above tests shall be furnished by the Contractor, at his own expense.

(n) **Painting Valves.**—After testing, the inside and outside surfaces of all iron castings shall be thoroughly cleaned and dried and painted with three coats of Wailes-Dove-Hermiston's Bitumastic Superservice Black, or approved equal.

SECTION 312

STANDARD HIGH PRESSURE HYDRANTS

(a) **General.**—Standard high pressure hydrants are of the type known as the "O'Brien Hydrant-High Pressure Type" and are identical with those at present in service in the Auxiliary Water Supply System. A sample of these hydrants can be inspected at the Maintenance Yard.

(b) **Patents.**—The Contractor shall protect the City, its officers and employees as required by the provisions of Section 7 (c).

(c) **Drawings Furnished by City.**—The general dimensions and arrangement of the hydrants are shown on the Plans. The Engineer will furnish to the Contractor, drawings showing details of all the hydrant parts, the kind of finish to be put on all surfaces, the limits of accuracy within which the work is to be performed, and all necessary shop directions.

(d) **Workmanship.**—All threads of valves, stems, nozzles, caps and glands shall be cut in a lathe.

The threads of all bolts and studs shall be cut with the greatest care and accuracy and all nuts shall be tapped so as fit the bolts neatly. The surfaces against which nuts and bolt heads bear, and the bearing surfaces of all nuts and bolt heads shall be faced to form true surfaces at right angles to the axis of the bolts.

On assembling the Hydrants, the threads of all bolts and studs shall be coated with graphite and oil immediately before screwing on the nuts.

(e) **Marking Hydrant Parts.**—Each individual part of the hydrant shall be marked with the Pattern and Part number as indicated on the drawings, the serial number of each casting or individual

piece of the same form or type, and with such other figures or letters as are herein specified, all in a manner satisfactory to the Engineer.

On such parts as the Inspector considers it impracticable or undesirable to cast the designated letters and figures, such letters and figures may be stamped into the individual parts or they may be eliminated with the approval of the Engineer.

In case any individual part shall be rejected, the letters S.F. A.W.S. and the serial number shall be erased by the Contractor under the supervision of the Inspector. The serial numbers shall in no case be duplicated and in the event of the same serial number appearing on two parts of the same form, the last part to be made shall be rejected.

The castings for the elbow, top plate, and stand-pipe shall have raised numbers and letters not less than one inch in height and one-eighth of an inch in relief cast on the outer side indicating: the running number of the castings of the same form, the initials of the maker's name, the year in which it was made, the letters S.F. A.W.S. and such letters and figures as herein elsewhere specified.

The casting for the bonnet shall be marked on the top side with raised letters, figures and direction arrows one-eighth of an inch in relief, as indicated on the drawing and on the under side, in a similar manner with the initials of the maker's name and the running number of the casting.

Each casting shall also be marked with raised letters and figures three-fourths of an inch high by one-eighth of an inch in relief; indicating the pattern number.

Arrangement of letters and figures shall be done in such manner as the City Engineer may approve.

(f) Iron Castings.

General.—Cast Iron shall conform to the requirements of the current A.S.T.M. Standard Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Designation A-126, Class B.

Transverse and Tensile tests shall be made from standard test bars specified under the above designated specifications, when required by the Engineer.

Should the average result obtained from the best three out of four test bars of any heat or run of metal tested, fail to come up to the required standard, all castings made from that heat or run of metal shall be rejected.

Allowable Variation in Thickness.—The thickness of the metal of the stand-pipe and elbow will be tested by calipers after the castings have been freed from sand and cleaned. The total allowable variation shall not exceed one-sixteenth of an inch from the required thickness at any point.

(g) **Bronze Castings.**—Bronze castings shall be in accordance with the requirements therefor in Section 311 (h).

(h) **Tobin Bronze.**—Tobin Bronze shall be in accordance with the requirements therefor in Section 311 (i).

(i) **Wrought Iron.**—Wrought Iron shall be in accordance with the requirements therefor in Section 311 (j).

(j) **Machine Steel.**—Machine Steel shall conform to the requirements of the current Standard Specifications for Carbon Steel and Alloy Steel Forgings of the A.S.T.M., Class C Annealed, Designation A18.

(k) **Hydrant Tests.**—After the hydrants have been assembled, they shall have all valves, seats, spindles, etc. removed and replaced in the presence of the Inspector, using for this purpose the wrench or wrenches provided by the City.

The hydrants shall then be subjected to the following tests at the shop. Any hydrant which fails to pass the tests shall be rejected.

Test No. 1.—The main valve shall be closed and the elbow, valve and valve seat shall withstand a hydrostatic pressure of 650 pounds per square inch without showing any leakage at the main valve in excess of a rate of $\frac{1}{2}$ fluid ounce per minute, or any sweating of the metal, or other defect.

Test No. 2.—The main valve shall be open and the independent valves closed and the body and all parts and fittings of the hydrant shall withstand a hydrostatic pressure of 360 pounds per square inch without showing any leakage at the independent nozzle valves, at a greater rate than $\frac{1}{2}$ fluid ounce per minute for all the valves, or any sweating of the metal or any other defect.

Test No. 3.—The main valve shall be open and the independent nozzle valve closed and the body and all parts and fittings of the hydrant shall withstand a hydrostatic pressure of 650 pounds per square inch, and be subjected to a hammer test without showing any sweating of the metal, leakage or any other defect, except the allowable leakage of the independent nozzle valves as allowed in Test No. 2.

Test No. 4.—The main valve shall be closed, and the hydrant shall withstand a pressure of 360 pounds per square inch, without showing any sweating of the metal, leakage of the main valve or other defect.

If, during the tests, any valve seat or other part of the hydrant is, in the opinion of the Engineer, injured by grit or other foreign matter getting into the hydrant, the damaged part shall be replaced or repaired by the Contractor at his own expense.

(l) **Painting Hydrants.**—After testing, the hydrants shall be thoroughly cleaned and dried inside and outside, and all accessible iron surfaces below the ground line shall be painted with 3 coats of Wailes-Dove-Hermiston's Bitumastic Superservice Black, or approved equal.

The outside surfaces of the hydrant above the ground line shall be painted with 3 coats of red lead paint.

SECTION 313

CAST STEEL SPECIAL CASTINGS

(a) **General.**—The steel castings covered by this Section are of the City's own special design, and include Sleeves, Crosses, Tees, Valve Reducers, Type 2 Double Bell Elbows, Equalizer Rings, and Strongbacks, and other special castings. All castings shall be in strict accordance with the plans and drawings, or the samples provided by the City.

Before being coated, as required in Subdivision (g) below, all the castings shall be subjected to a hydrostatic test pressure for a period of not less than four minutes. The castings shall be subjected to a hammer test while under pressure. The following hydrostatic pressures will be used in testing the different classes of cast-iron specials.

Class	Test Pressure
E-F Specials	600 lbs. per sq. inch
G-H Specials	650 lbs. per sq. inch

Any casting which shows any defect by leaking or sweating, which cannot be stopped by peining, shall be rejected.

(b) **Cast Steel.**—Cast Steel shall conform to the requirements of the current Standard Specifications of the A.S.T.M. for carbon steel castings for Miscellaneous Industrial Uses, Grade B-2, Full Annealed, Designation A-27.

(c) **Test Specimens.**—Test Specimens, as required by the above specifications shall be furnished by the Contractor.

(d) **Workmanship.**—All castings shall be made in such molds and with such cores as will render the castings clean, smooth and free from cooling strains.

The castings shall be true to patterns, sound and free from all defects or imperfections of any kind which, in the judgment of the Engineer, render them unfit for the use for which they are intended. All projections resulting from gates or risers shall be cut off and ground smooth with the surface of the casting.

No plugging or welding of defects will be permitted unless with the approval of the City Engineer.

(e) **Allowable Variations in Dimensions and Weight.**

Gauges.—The Contractor shall furnish all the necessary tolerance gauges and any other gauges which may be required by the Inspector to check the dimensions of the castings for conformity with the drawings and the allowable tolerances.

Diameters.—The inside diameter of the bells and the outside diameter of the spigot ends shall not vary from the standard dimen-

Section 313

sions by more than .06 of an inch for nominal diameters of 16 inches or less, and by .08 of an inch for nominal diameters larger than 16 inches.

Thickness.—The thickness of material must not be more than 1/16 of an inch less than, or 1/8 of an inch more than the dimensions shown on the drawings.

Weight.—No casting will be accepted which weighs less than 95 per cent of the Standard Weight. For any individual casting, no excess of 5 per cent above standard weight will be paid for. For total number of castings, no excess of 3 per cent above the sum of the standard weights will be paid for. The Standard Weight is computed by the Engineer from the standard drawings, assuming cast steel to weigh 0.2836 pounds per cubic inch.

(f) Marking Castings.—Every casting shall have distinctly cast upon the outside surface in raised letters not less than 1½ inches in length and 1/8-inch in relief, S.F.; A.W.S.; the abbreviated name of the district or extension for which it is ordered; the running number of the casting of each particular size and class; the nominal diameter; the class; the initials of the manufacturer's name; the year in which it was cast, and the drawing number, as per example:

S.F.

A.W.S. Miss.; 16, 12"x10", G.H. A.B.F. Co. 1947; HPL-5141-5.
Letters shall be arranged in a manner satisfactory to the City Engineer.

In case any casting shall be rejected the letters S.F. and the A.W.S.

running number shall be erased by the Contractor under the supervision of the City's Inspector. The running number of rejected castings shall not be duplicated.

(g) Coating.—After testing, every casting shall be thoroughly cleaned and shall then be coated inside and outside in the manner specified above for cast iron pipe, under Coating in Section 310 (h), all the requirements of which shall apply.

(h) Castings to be Weighed.—After the coating has hardened the castings shall be weighed at the place of manufacture, under the supervision of the Inspector, on correct scales provided by the Contractor and tested with U.S. Standard Weights whenever required by the City's Inspector. The weight and class-letter for each casting shall be distinctly marked on the inside of the casting with white paint.

SECTION 314

CAST IRON SPECIAL CASTINGS

(a) **General.**—Iron castings covered by this section are of the City's own special design, and include Sleeves, Caps, Plugs, Offsets, Line Reducers, Valve Reducers, Hydrant Tees, Blow-off Tees, Type I B&S Elbows, Type 3 D.S. Elbows, Fire Boat Wharf Manifolds, and other special castings. All castings shall be in strict accordance with the plans and drawings, or the samples provided by the City.

(b) **Cast Iron.**—The cast iron shall conform to the requirements of the current A.S.T.M. Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings, Class A, Designation A-126.

(c) **Tests and Test Specimens.**—Test specimens, as required by the above specifications, shall be furnished by the Contractor at his own expense, to the Engineer for testing by the City.

(d) **Workmanship.**—All castings shall be made in such molds and with such cores as will render the castings clean, smooth and free from cooling strains. Castings shall remain in the flasks a sufficient length of time to prevent unequal contraction in cooling.

The castings shall be true to pattern in accordance with the drawings, sound and free from all defects or imperfections of any kind, which in the judgment of the Engineer, render them unfit for the use for which they are intended. No plugging or filling will be allowed. All projections resulting from gates or risers shall be cut off and ground smooth and even with the surface of the casting.

(e) **Allowable Variations in Dimensions and Weight.**

Gauges.—The Contractor shall furnish standard circular gauges and other gauges which may be required by the Inspector to check the dimensions of the castings for conformity with the drawings and the allowable tolerances.

Diameters.—The inside diameter of the bells and the external diameters of the spigot ends shall not vary from the standard dimensions by more than 0.10 of an inch for bells and spigots fourteen inches or less in nominal diameter; and 0.12 of an inch for bells and spigots more than fourteen inches in diameter.

Thickness.—For castings whose standard thickness is less than one inch, the thickness of metal shall not be more than 0.12 of an inch less than the standard thickness. For castings whose standard thickness is one inch or more, the variation shall not exceed 0.15 of an inch.

Weight.—No casting will be accepted which weighs less than 92 per cent of the standard weight. For any individual casting, when payment under the contract is by weight, no excess of eight per cent above standard weight will be paid for, and for total number of castings, no excess of four per cent above the sum of the standard weights

will be paid for. The standard weight is computed by the City Engineer from the drawings, assuming cast iron to weigh 0.2604 pounds per cubic inch.

(f) Marking Castings.—Every casting shall have distinctly cast upon the outside surface in raised letters not less than $1\frac{1}{2}$ inches in length and $\frac{1}{8}$ -inch in relief, S.F.; A.W.S.; the abbreviated name of the district or extension for which it is ordered; the running number of the casting of each particular size and class; the nominal diameter; the class; the initials of the manufacturer's name; the year in which it was cast, and the drawing number, as for example:

S.F.

A.W.S. Miss.; 16, 12"x10"; G.H.; A.B.F. Co.; 1947 HPL-5. The letters shall be arranged in a manner satisfactory to the Engineer. In the case of elbows, the amount of bend shall also be indicated as above.

In case any casting shall be rejected, the letters S.F. and the A.W.S.

running number shall be erased by the Contractor under the supervision of the Inspector. The running number of rejected castings shall not be duplicated.

(g) Hydrostatic Test.—The castings shall be subjected to a hydrostatic test pressure for a period of not less than four minutes. The castings shall be subjected to a hammer test while under pressure. The following hydrostatic pressures will be used in testing the different classes of cast-iron specials.

Class	Test Pressure
A-B Specials	300 lbs. per sq. inch
C-D Specials	400 lbs. per sq. inch
E-F Specials	520 lbs. per sq. inch
G-H Specials	650 lbs. per sq. inch
Manifolds	650 lbs. per sq. inch

Any casting which shows any defect by leaking or sweating which can not be stopped by peining shall be rejected.

(h) Coating.—After testing, every casting shall be thoroughly cleaned and shall then be coated inside and outside in the manner specified above for cast-iron pipe, under Coating in Section 310 (h), all the requirements of which shall apply.

(i) Castings to be Weighed.—After the coating has hardened, the castings shall be weighed at the place of manufacture, and the weight and class letter distinctly marked on the inside of the casting with white paint. All weighing and marking shall be done under the supervision of the Inspector on correct scales furnished by the Contractor and tested with U.S. Standard weights whenever required by the Inspector.

SECTION 315

CASTINGS FOR VALVE VAULTS, VALVE BOXES, SHIELDS

(a) **General.**—This section, or item, covers iron castings of the City's own special design, and includes Frames, Covers, and Dust Pans, for Valve Vault Manholes and for Valve Boxes; Valve Boxes; and Shields for Sewer Cross-Over. All castings shall be in strict accordance with the plans and drawings.

(b) **Cast Iron.**—The cast iron shall conform to the requirements of the current A.S.T.M. Standard Specifications for Gray Iron Castings for Valves, Flanges and Pipe Fittings, Class A, Designation A-126.

(c) **Tests and Test Specimens.**—Test specimens as required by the above specifications shall be furnished by the Contractor at his own expense, to the Engineer for testing by the City.

(d) **Workmanship.**—All castings shall be made in such molds and with such cores as will render the castings clean, smooth and free from cooling strains. Castings shall remain in the flasks a sufficient length of time to prevent unequal contraction in cooling.

The castings shall be true to pattern in accordance with the drawings, sound and free from all defects or imperfections of any kind, which, in the judgment of the City Engineer, render them unfit for the use for which they are intended. No plugging or filling will be allowed. All projections resulting from gates or risers shall be cut off and ground smooth and even with the surface of the casting.

(e) **Allowable Variations in Weight.**—No casting will be accepted which weighs less than 92 per cent of the standard weight. For any individual casting, when payment under the contract is by weight, no excess of 8 per cent above standard weight will be paid for. For total number of castings, no excess of 4 per cent above the sum of the standard weights will be paid for. The standard weight is computed by the City Engineer from the standard drawings, assuming cast iron to weigh .2604 pounds per cubic inch.

The bearing surfaces of the frames and covers shall be finished and perfectly true, and interchangeable in position and with each other.

(f) **Castings to be Weighed.**—All castings shall be weighed at the place of manufacture under the supervision of the Inspector, on correct scales provided by the Contractor and tested with U.S. Standard Weights whenever required by the Inspector. Each casting shall have its weight indicated thereon in white paint.

(g) **Payment.**—When castings for Valve Vaults and Valve Boxes are covered by a unit bid item in the contract, the price bid therefor shall include full compensation for installation in accordance with Section 336 below.

SECTION 316

BOLTS, TIE RODS, TURNBUCKLES, ETC.

(a) **General.**—The Contractor shall furnish and install all connecting devices such as bolts, tie rods, nuts, sleeve nuts, turnbuckles, and washers, necessary for the bolting together of pipe joints and other connections and parts of pipe lines. Such devices shall conform to the standard detail drawings, except special lengths which may be required by the Engineer.

All washers shall be perfectly flat and true to required dimensions, and all nuts and bolts shall have their bearing surfaces smooth and at right angles to the axis of the thread.

All threads shall be thoroughly coated with lubricating oil to which has been added flake graphite in the amount of one ounce per quart of oil.

(b) **Material.**—All of the above connecting devices shall be of wrought iron conforming to the current Standard Specifications of the A.S.T.M. for Single and Double Refined Wrought Iron Bars, Designation A-189.

(c) **Wire Binders.**—Wire binders for the purpose of holding bolts and rods firmly in place in the lugs shall be furnished and installed by the Contractor. They shall consist of 3 turns of No. 10 B.W.G. soft iron wire, wrapped tightly around the entire set of bolts or rods, and with the ends twisted tightly together.

For each set of bolts or rods less than 24 inches in length, one binder will be required.

For each set of bolts or rods 24 inches or more in length, two binders will be required, each binder being placed as close to lugs as possible.

(d) **Painting.**—After installation, all the bolts, nuts and other connecting devices included in this section shall be painted with two coats of the Paraffine Company's No. 2 P&B paint, or approved equal.

(e) **Payment.**—When the bolts, tie rods, nuts and other connecting devices included in this section are covered in the contract by a unit bid item, the price bid therefor shall include full compensation for installation and all incidental work. In estimating the weight to be paid for no allowance will be made for the weight of wire binders.

SECTION 317

PIG LEAD

Lead shall conform to the requirements of the current Standard Specifications of the A.S.T.M. for Pig Lead, Grade III Common Lead, Designation B-29.

When lead is furnished as an item under a unit price bid, the

quantity to be paid for shall be determined from the tables on the detail drawings, showing the amount of lead required for joints in several types and sizes of pipe and appurtenances.

SECTION 318

YARN

Yarn used for joint packing shall be braided or twisted jute packing yarn of uniform quality, free from tar, and satisfactory to the Engineer.

PART VII
AUXILIARY WATER SUPPLY SYSTEM
FOR FIRE PROTECTION

CHAPTER III. INSTALLATION

SECTION 330
EXCAVATION

(a) General.—Except as otherwise provided herein, in the Special Provisions, or in the Plans, all trenching or other excavation shall be done in accordance with the requirements for sewers, in Sections 150, 151, and 152.

(b) Test Pits.—Whenever the Engineer may require additional information regarding existing subsurface structures, the Contractor shall excavate test pits of such dimensions and at such points as the Engineer may direct.

Payment for test pits will be made at the unit prices bid for excavation, and repaving. The quantities to be paid for shall be determined from the dimensions prescribed by the Engineer for the excavations.

(c) Width and Depth of Trench.—The requirements of this subdivision shall apply when excavation of trenches and restoring pavements, are covered in the contract by unit bid prices therefor.

The standard width of pipe trenches shall be as follows :

Nominal Diameter of Pipe	Width of Trenches
20 inches	36 inches
18 inches	33 inches
16 inches	31 inches
14 inches	29 inches
12 inches or less	24 inches

If lagging is required, the standard width of trench will be the above width plus four inches irrespective of actual thickness of lagging. Ample space must be provided to allow the caulkers to reach and thoroughly caulk all around the joints. Space must also be provided at sides and bottom of trench for the lugs on pipes and appurtenances and for the bolts connecting them.

The trench shall be excavated to such depth as will allow the center line of the pipe to be 5 feet below the grade of the street, except as otherwise necessary, to avoid obstructions, enter vaults, or as otherwise provided in the Special Provisions or Plans, or directed by the Engineer.

The quantity of excavation to be paid for shall be determined, by the method of average end areas, from the actual trench depth multiplied by the standard width of trench specified above. Trench depths shall be measured at all breaks of grade, but in no case at a greater interval than 50 feet.

No allowance will be made for excavation outside the standard trench made on account of bells, lugs, bolts and the like, as required above, and the cost thereof shall be considered included in the price paid for excavation of trench of standard width.

Where two trenches or a trench and another excavation intersect, the cubic contents of the excavation will be allowed only once.

Where tunneling is permitted, payment shall be made only for the volume actually excavated.

(d) Excavation for Valve Vaults, Hydrants, Etc.—When the contract provides for payment at a unit price for excavation for valve vaults, other structures, and concrete blocks under hydrants, the quantity of excavation to be paid for shall be the volume included within vertical planes 6 inches outside the outside planes of the structure.

(e) Backfilling, Restoring Pavements.—After the mains, pipes, and appurtenances have been installed, tested, and inspected, the excavations shall be backfilled, and temporary and permanent pavements shall be constructed in accordance with the requirements therefor, for sewers in Sections 167 and 168.

SECTION 331

LAYING PIPE

(a) General.—This heading, or item, Laying Pipe, includes the furnishing of all labor, materials, tools, and appliances necessary for, and the handling and loading of pipe at the Maintenance Yard, hauling to the place of installation, laying the pipe in the trench, making joints, testing all joints in the pipe lines and appurtenances, making all necessary connections with mains not in the contract, the setting of all branches, caps, plugs and other special castings, together with all necessary incidental work, not included under other items.

(b) Cutting and Marking Pipes and Nipples.—All cutting and grooving of pipes or nipples, excepting the cutting of pipe risers for valve boxes, shall be done in a machine shop with a machine which, in the judgment of the Engineer, is suitable for this purpose. The cut ends of the pipe or nipples shall be clean and straight and the cut grooves shall conform with the drawings as to shape, size and location.

Every nipple cut from a longer piece of pipe shall have painted thereon with yellow paint and in easily readable letters, the size, class, serial number, and year of manufacture of the original full length of pipe, also the name of the job to which the nipple or short length of pipe is allocated and the serial number of the nipple in the particular job, in the following manner:

10"	—	A	—	size and class
761	—			original serial number of pipe
1947	—			year of manufacture
Pot. C	—			name of job in which cut length is to be used
1	—			serial number of nipple or cut length

The length of pipe from which the nipples have been cut, shall, if the original cast on letter has been destroyed, also have the size, class, original serial number and year of manufacture painted on, in easily readable yellow letters on the outside of the pipe and also on the inside near the spigot end.

(c) Cleaning Castings.—All pipes and other castings, and all valves, hydrants, etc. shall be cleaned by the Contractor by brushing and washing out all dirt or other foreign matter, immediately before laying, to prevent any foreign matter entering the mains. As the pipe laying proceeds, a proper mandrel shall be provided by the Contractor, which shall be drawn forward as each pipe or special casting is laid. All branches or other openings shall be protected by turned wooden plugs or heads until permanent connections are made. During the progress of the work the mains shall be kept thoroughly clean throughout and left clean. If, in the final inspection of the work any obstruction or deposit is discovered in the mains it shall, upon demand by the Engineer, be removed at once by the Contractor.

(d) Serial Numbers.—All pipe and fittings shall be laid with their serial numbers facing upwards.

(e) Joints.

Bell and Spigot.—The spigot end of the pipe or special casting shall be inserted into the bell the full depth of the bell and the spigot adjusted in the bell so as to give a uniform space for the joint, which shall be made of yarn packing of the quality hereinbefore specified, and lead or lead wool as directed. The packing shall be thoroughly and evenly packed into the bell so as to fill it tightly for a depth of 1 inch. The remaining space shall then be filled with lead, a bead being left on the outside of the face of the bell sufficient to allow for caulking so that when the joint is properly caulked the lead will be flush with the face of the bell. The use of cold plugs will not be allowed.

Double Spigot.—In laying double spigot pipe and in installing sleeves on bell and spigot or double spigot pipe, the sleeve shall be so adjusted as to be central with both pipes and cover each pipe equally so as to make an equal joint space both radially and along the axis of each pipe. Proper reference marks shall be placed on each pipe in a manner satisfactory to the City Engineer to insure that the sleeve shall not be displaced in caulking the joint, and the joint shall be so caulked as to prevent such displacement. The two joints of sleeves shall receive alternate partial caulking, and the manner of making the joints shall be such as will prevent material endwise displacement of the sleeves. Other methods of caulking may be employed if satisfactory to the Engineer.

On Grades.—Where pipe is laid on grades, the bells pointing down grade shall have the lead joint so made as to avoid any material collection of air bubbles at the top of the joint. Should the grade be so steep as to render the use of poured lead joints inadvisable in the

opinion of the Engineer, the Contractor shall use lead wool in the joints. The lead wool will be put in in thin rings, each of which must be thoroughly compacted by caulking. Pipe, where practicable, must be laid with bells facing up grade. No extra allowance will be made for the use of lead wool.

Pouring Lead.—The melting pot shall be kept near the joint to be poured and only one pouring shall be made for each joint. The joint shall be perfectly clean and dry when the lead is applied. Dross shall not be allowed to accumulate in the melting pot. The joints shall be thoroughly caulked by competent workmen, by means of proper and satisfactory tools, in such a manner as to secure a tight joint without overstraining the iron in the bells. In all cases, the caulking shall be done towards the gate and other points where the lead is likely to be porous, so as to compact it there. Care shall be taken in making joints to provide suitable escape for the air in the joint when it is being poured.

(f) Bracing of Pipe Lines.—All bends, offsets, dead ends, hydrant tees, and crosses with plugged outlet, shall be braced with wedge shaped concrete anchor blocks containing 6 to 12 cubic feet. These blocks shall be of Class "B" concrete, and of such size as the Engineer may direct, and shall be poured against undisturbed ground in the bottom and side of trench. The backfill around the blocks shall be thoroughly tamped.

(g) Connections With Existing Pipes.—The Contractor shall make connections with existing pipes and appurtenances, and those installed under other contracts, as shown on the plans, or as necessary.

(h) Payment.—When Laying Pipe is a bid item under the contract, to be paid for at the unit price bid therefor, the quantity to be paid for shall be the actual length of the installation in place measured along the center lines of pipes, tees, crosses, bends, reducers, caps, plugs and other special castings.

Plugged outlets of tees and crosses shall be measured from center of main pipe to extreme point of the cap, and payment therefor shall be at the unit price bid for laying pipe of the diameter of the largest branch of such tee or cross.

Payment for laying reducers shall be at the unit price bid for laying pipe of the diameter of the larger end of such reducer.

Hydrant branches shall be measured from the center line of the main to the inner face of bell of the hydrant.

The laying lengths of valves—the distance between inside faces of bells—shall not be included in measurements of quantities under this item.

Allowance for Extra Joints on Account of Specials.—An adjustment in the payment for laying pipe will be made when the number of joints varies from the normal number defined below.

The normal number of joints shall be the quotient obtained by dividing the length in feet of the pipe line, including specials but ex-

Section 332

cluding valves, by eleven in the case of bell and spigot pipe, and by five and one-half in the case of double spigot pipe.

If the number of joints actually made is greater than the normal number, an allowance will be made for each additional joint, and if the number of joints actually made is less than the normal number, a corresponding deduction will be made.

The allowance or deduction will be made at the rate of \$5.00 per joint for main line pipe, and at the rate of \$4.00 per joint for hydrant connections.

SECTION 332

INSTALLING VALVES

(a) **General.**—This heading, or item, includes the handling and loading of the valves at the Maintenance Yard, or Contractor's Shop, hauling to the place of installation, setting the valves in the pipe line, making the lead joints between valves and pipes in the manner specified for joints in bell and spigot pipe, testing the joints and the furnishing of all necessary labor, materials, tools, and appliances, together with all necessary incidental work not included under other items.

(b) **Payment.**—When the installation of valves is covered in the contract by bid items for valves of different sizes, then the work included above in this section will be paid for at the respective unit prices bid for the different valves.

SECTION 333

AIR VALVES

(a) **General.**—The Contractor shall tap the main and furnish and install air valves complete with connections and appurtenances, as and where shown on the plans, or directed by the Engineer.

(b) **Payment.**—When the cast-iron pipe main is paid for at a unit price bid under the contract, each air valve will be paid for as follows:

A payment of \$6.00 will be made to the Contractor which shall be compensation for drilling and tapping main and furnishing and installing valve, riser and 8" cast-iron pipe. The valve box castings and the reinforced concrete box will be paid for at the respective unit prices bid therefor.

SECTION 334

INSTALLING HYDRANTS

(a) **General.**—This heading, or item, includes the handling and loading of the hydrants at the Maintenance Yard, or Contractor's Shop, hauling to the place of installation, setting the hydrant in place, making the lead joint to the hydrant connection, and the furnishing of

all necessary labor, materials, tools and appliances, together with all necessary incidental work not included under other items.

Each hydrant shall be carefully examined, the elbow and foot valve shall be thoroughly cleaned, and all dirt and foreign matter shall be removed, before setting the hydrant.

Hydrants shall be set exactly plumb, and at the proper elevation on a block of reinforced concrete, or in recesses in vaults, as shown on the plans. The lead joint to the 8" hydrant connection shall be made, as specified for joint in bell and spigot pipe.

In compacting backfill around hydrants, special care shall be taken to keep them plumb, and to give them adequate support to prevent future movement. Any hydrant which is out of plumb, or which is not firmly supported, shall be properly reset by the Contractor at his own expense.

After the hydrants are in place, the portion above the ground level shall be given two coats of paint composed of turpentine, linseed oil, and pure white lead ground in oil, and of colors approved by the Chief Engineer of the Fire Department.

(b) Payment.—When installing hydrants is covered in the contract by a unit bid item, then the work included above in this section will be paid for at the unit price bid. The excavation, backfill, reinforcing steel, concrete, and sidewalk will be paid for at the respective unit prices bid therefor.

SECTION 335

INSTALLING FIRE BOAT WHARF MANIFOLDS

(a) General.—This heading, or item, includes the handling and loading of manifolds at the Maintenance Yard or other location in the City, or at the Contractor's Shop, hauling to the place of installation, setting the manifold in place, furnishing and installing the 16" pipe nipple connecting the manifold tee to the vertical elbow, furnishing and installing bleeder valve, making and testing joints, and the furnishing of all necessary labor, materials, tools and appliances, together with all necessary incidental work not included under other items.

Each manifold shall be carefully examined, and any dirt or foreign matter shall be cleaned from the interior. Special care shall be exercised to insure that the inlets and flapper valves are in no way damaged. The manifold shall then be set exactly plumb and firmly bolted to the foundation.

A bleeder valve unit, as shown on the plans shall be furnished and connected to each manifold.

When connected to the pipe line all joints and parts of the manifold shall be tested, and shall withstand a hydrostatic pressure of 450 pounds per square inch without any leaks whatever.

After testing, the parts above ground, except the caps and threads on the inlets, shall be given two coats of paint composed of turpentine,

Section 336

boiled linseed oil, and pure white lead ground in oil, and of a color approved by the Engineer.

(b) **Payment.**—When the installation of manifolds is covered in the contract by a unit bid item, then the work included above in this section will be paid for at the unit price bid. The excavation, backfill, reinforced concrete or structural steel foundations, bolts, nuts and washers, and lead for joints will be paid for at the respective unit prices bid therefor.

SECTION 336

VALVE BOXES

(a) **General.**—Valve box assemblies shall be constructed, as shown on the plans, over all air valves, 8-inch valves, and 10-inch valves. They shall be set exactly plumb, with a cast-iron frame and cover conforming to the pavement surface. The concrete block shall not be poured till the backfill on which it is to rest is thoroughly compacted. The required cast-iron riser shall be furnished by the Contractor.

(b) **Payment.**—When the contract is let on a unit price basis, payment for valve boxes shall be made at the unit prices bid respectively for the several component parts, except that the cost of furnishing and installing pipe riser shall be included in the price bid for setting valve.

SECTION 337

VALVE VAULTS

(a) **General.**—Valve vaults of reinforced concrete shall be constructed, as shown on the plans, or directed, for all 12-inch and larger valves. They shall be built in accordance with the plans if there is sufficient room for them in the street, otherwise they shall be built of such size and shape as may be ordered by the Engineer. All valve vaults shall be made water-tight by the Contractor. The cast-iron frames and covers shall be set to conform to the pavement surface, and so that the length of the lifting handles shall be in the direction of street traffic.

(b) **Payment.**—When the contract is let on a unit price basis, payment for valve vaults shall be made at the unit prices bid respectively for the several component parts.

SECTION 338

HYDROSTATIC FIELD TESTS

(a) **General.**—In order to insure the water tightness of the pipes and appurtenances they shall be tested after installation, but before

the joints are backfilled, by being subjected to hydrostatic tests at the following pressures :

Class G or H Pipe	450 pounds per square inch
Class F	Pipe 400 pounds per square inch
Class E	Pipe 350 pounds per square inch
Class D	Pipe 300 pounds per square inch
Class C	Pipe 250 pounds per square inch
Class B or A Pipe	200 pounds per square inch

The tests shall be made between slip plugs or valves on the mains and shall include the hydrant branches either up to the 8-inch valve or to the foot valve of the hydrant, as the Engineer may direct. Where the main line test extends only to the valve on a hydrant branch, the portion of the 8-inch pipe between the valve and the hydrant shall be separately tested.

The instruments necessary to make the tests will be furnished by the City at the Maintenance Yard. The Contractor shall transport such instruments at his own expense from and to the Yard, and about the work, as directed. He shall furnish all the labor and material necessary to make the tests and to perform any work incidental thereto. The trench between joints shall be partially backfilled before making tests.

The Contractor shall take all necessary precautions to prevent any joints drawing while the mains and their appurtenances are being tested, and he shall, at his own expense, repair any damage to the mains and their appurtenances, or any other structures resulting from or caused by the tests.

(b) Permissible Leakage.—The leakage from the pipes and appurtenances for each section tested under the above pressures shall not be greater than $\frac{1}{8}$ of a gallon per linear foot of pipe joint per 24 hours. The length of pipe joint shall be determined from the inside diameter of the pipe.

The test pressure shall be maintained for not less than 20 minutes, and the amount of water forced into the main during the test shall be determined, and from this amount there shall be computed the actual leakage per foot of joint per 24 hours.

If the leakage be at a greater rate than that specified, the Contractor shall recalk the joints and replace the defective work until the leakage shall be reduced to not more than the allowable amount.

(c) Connections to Existing Mains.—When a connection is made with a main which is not in the contract, the portion of the new main laid under the contract between the connection and the nearest valve on the new main, shall not be backfilled until completion of the test of the new work on the far side of such valve from the connection. If, during this test, any defects or leaks appear in the pipe or appurtenances on the connection side of the valve, such defects or leaks shall be satisfactorily remedied by the Contractor at his expense.

Section 339

(d) **Defects in Castings Furnished by City.**—If, upon examination, the Contractor can show that the failure of a test is due to a defective casting furnished by the City, then he shall be paid for the work of replacing such casting with a new casting furnished by the City, and for work necessarily incidental thereto. Such payment shall be made at the respective unit prices bid under the contract for the different items, except that work not covered by such bid prices shall be paid for as Extra Work under Section 10 (b).

(e) **Payment.**—No direct payment will be made for tests, all the cost of which shall be considered included in the price bid for laying pipe, or other appropriate item or lump sum bid.

SECTION 339

CONCRETE SLAB OVER TRENCH

Wherever directed by the Engineer, the Contractor shall install over the pipe trench, a reinforced concrete slab as shown on the plans.

When the contract is let on a unit price basis, payment for such reinforced concrete slabs shall be made at the unit price bid respectively for the several component parts.

SECTION 340

MELTING JOINTS

Whenever it is necessary to disconnect an existing lead joint, either in connecting to or making alterations in existing pipes, or otherwise, the lead shall be carefully melted out by means of a blow torch or other suitable flame.

Under no circumstances shall a bonfire, or other means which might unnecessarily heat the pipe, be used.

INDEX

	Page		Page
A		Backfill—Continued	
A.A.S.H.O.....	7	for electrical work.....	151
Abandoned sewers and structures....	118	of excessive excavation with con- crete.....	127
Acceptance—		over and around sewers and struc- tures.....	119
date of, definition.....	8	Barricades.....	28
of part of the work.....	22	Bars, reinforcing.....	58
of the work.....	38	Base—	
use before.....	21	asphaltic concrete (black base)....	97
Addendum to Specifications.....	11	for pavement, concrete, type “A”.....	87
Additional drawings may be fur- nished by Engineer.....	26	for pavement, concrete, type “B”.....	88
Address of Contractor.....	16	waterbound macadam.....	98
Advertisement.....	7	Basement, conduit in.....	144
Aggregate—		Bending reinforcing steel bars.....	58
coarse.....	42	Bends in conduit.....	144
fine.....	41	Bidder—	
Air valves, A.W.S.S.....	180	definition of.....	7
Allowable stresses—		must make thorough investigation	10
Douglas Fir.....	68	Bidders—	
Redwood.....	63	instruction and information for..	9
Aluminum paint.....	138	qualifications of.....	11
American Association of State Highway Officials.....	7	Bid prices to cover entire work.....	11
American Society of Testing Materials.....	7	Bids, opening of.....	9
Amount of work, change in.....	10	Bids, unbalanced.....	9
Anchor blocks for pipe A.W.S.S.....	179	Binders, wire, A.W.S.S.....	174
Anticipated profits.....	37	Bituminous poured joints for V.C.P. sewers.....	110
Approximate, Approximately, Def- inition of.....	7	Bituminous sewer joint compound....	51
Armor coat, emulsified asphalt.....	101	Black base, asphaltic concrete.....	97
Armored concrete curb.....	75	Boat spikes, holes in timber for.....	124
Armor for armored concrete curb.....	76	Bolts—	
Arterial stop signs, relocation of.....	149	nuts, washers, galvanizing.....	123
Asbestos cement conduit.....	145	tie rods, turnbuckles, etc. A.W.S.S.	174
Asphaltic cement.....	49	Bonding, fresh to hardened concrete	131
spray coat.....	93	Bonding together of street lighting appurtenances.....	150
Asphaltic coating, corrugated pipe..	55	Bonds, Corporate Surety.....	13
Asphaltic concrete—		Borings, test.....	139
base (black base).....	97	Boxes, valve, A.W.S.S.....	182
conform pavement.....	96	Bracing, lagging and sheet piling— concrete structures.....	128
grading and proportions of mate- rials.....	94	sewers.....	105
laying.....	95	Bracing of pipe lines, A.W.S.S.....	179
mixing.....	94	Breach of Contract.....	32
rolling.....	96	Brick—	
smoothness.....	96	common.....	51
spray coat.....	95	invert.....	107
wearing surface.....	93	manholes.....	115
Authorized Agent.....	7	mortar for.....	43
Auxiliary Water Supply System for Fire Protection.....	153	pavement.....	91
A.W.S.S. tests on facilities after in- stallation.....	182	paving.....	52
		vittrified.....	51
B		Bronze castings for valves, A.W.S.S.	163
Backfill—			
A.W.S.S.	177		
concrete structures.....	128		
flooded sand.....	128		
for asbestos—cement and fiber conduit.....	145		

Index

C	Page	Cast iron pipe, A.W.S.S.—Continued	Page
Cable—		tests on.....	161
street lighting.....	142	thickness.....	159
cutting and splicing.....	147	weighing of.....	161
installation of.....	147	weight, permissible variation.....	159
tests on.....	152	Catchbasin castings, resetting.....	72
Casing for test borings.....	139	Catchbasins.....	116
Casting concrete piles.....	125	abandoning.....	118
Castings, cast iron (see cast iron)		moving.....	118
cleaning before laying, A.W.S.S....	178	reconstruction.....	118
defective, furnished by City,		Caulking pipe joints, A.W.S.S.....	178
A.W.S.S.....	184	Cement—	
for valve vaults, valve boxes,		asphaltic.....	49
shields, A.W.S.S.....	173	definition of.....	7
Castings, special, iron, A.W.S.S.....	171	Portland.....	40
coating.....	172	sacked (see Concrete)	
description.....	171	Cement-asbestos conduit.....	145
dimensions, permissible variation	171	Center strip pavement, concrete.....	90
iron for.....	171	Central Mixing Plant.....	46
marking.....	172	Certified check to accompany propo-	
specimens, test.....	171	sal.....	11
tests on.....	172	Chairs for reinforcing steel.....	58
test specimens.....	171	Changes—	
weighing.....	172	in amount of work.....	10
weight, permissible variation.....	171	in the work.....	10, 36
workmanship.....	171	Charter.....	7
Castings, special, steel, A.W.S.S....	169	Check, certified.....	11
coating.....	170	Check Valves, A.W.S.S.....	162
description.....	169	City.....	7
dimensions, permissible vari-		City Engineer.....	7
ation.....	169	City Monuments.....	30
marking.....	170	Classes of concrete.....	44
specimens, test.....	169	Cleanup of the work.....	32
steel for.....	169	Coarse aggregate.....	42
tests on.....	169	Coat, armor, emulsified asphalt.....	101
test specimens.....	169	Collusion.....	10
weighing of.....	170	Combined curb and gutter.....	78
weight, permissible variation.....	169	Commencement of work.....	24
workmanship.....	169	Common brick.....	51
Castings, steel.....	56	Compensation insurance.....	13
Cast iron.....	55	Compliance, proofs of.....	24
Cast iron fittings for pipe.....	60	Concrete base—	
Cast iron, measurement of.....	36	type "A" (6" thick).....	87
Cast iron pipe.....	60	type "B" (8" thick).....	88
Cast iron pipe, A.W.S.S.....	157	Concrete, bonding fresh to hardened	131
casting procedure.....	160	Concrete center strip pavement.....	90
cleaning and inspection.....	160	Concrete curb—	
coating of.....	160	armored.....	75
defective spigots.....	158	armor.....	76
description of.....	158	concrete.....	76
dimensions, permissible variation	159	construction joints.....	76
drawings.....	157	Contractor's name on.....	77
hydrostatic tests on.....	161	finishing.....	76
iron for.....	157	forms.....	75
lengths of.....	158	placing concrete.....	76
lugs.....	158	plaster facing.....	76
manufacture of.....	160	protection and curing.....	77
marking of.....	159	repairs and replacements.....	77
physical properties and tests.....	157	side sewer and Y-branch locations	
relation between diameters of dif-		to be marked on.....	77
ferent classes.....	158	street name on.....	77

Index

	Page
Concrete curb—Continued	
subgrade.....	75
Concrete, curing and protection.....	47
Concrete, definition of.....	7
Concrete finishes.....	132
class 1.....	133
class 2.....	133
class 3, gunite.....	133
class 4, stucco dash.....	133
ordinary.....	132
Concrete for structures.....	130
Concrete, lighting standard founda- tions.....	143
Concrete manholes.....	115
Concrete, measurement of.....	36
Concrete mixing.....	45
Concrete mixing at the work.....	46
Concrete pavement, Portland cement.....	83
coloring.....	86
concrete.....	84
construction joints.....	86
Contractor's name on.....	86
curing.....	86
dummy joints.....	86
expansion joints.....	85
finishing.....	84
headers.....	83, 84
placing and spreading.....	84
protection and curing.....	86
subgrade headers.....	83
Concrete piles, precast.....	124
unused, payment for.....	127
Concrete, placing.....	130
Concrete, Portland cement.....	44
central mixing plant.....	46
classes.....	44
general.....	44
mixing.....	45
mixing at the work.....	46
protecting and curing.....	47
repairing, imperfect.....	132
rubble.....	130
sewers.....	106
Concrete sidewalk, one course.....	82
Concrete sidewalk, two course.....	81
construction.....	81
Contractor's name on.....	82
curing.....	82
description of.....	81
expansion joints.....	82
forms.....	81
slope.....	81
street names.....	82
subgrade.....	81
Concrete slab over trench, A.W.S.S.....	184
Concrete structures.....	127
backfill.....	128
bonding concrete to hardened concrete.....	131
concrete.....	130

	Page
Concrete structures—Continued	
concrete surface finishes.....	132
concrete, placing.....	130
concrete, repairing imperfect.....	132
concrete, rubble.....	130
concrete, vibration of.....	130
construction joints.....	131
disposal of seepage and storm water.....	128
expansion joints.....	129
finish, concrete surfaces.....	132
forms.....	128
forms, removal of.....	132
form ties.....	129
grading and excavation.....	127
joints, construction.....	131
joints, expansion.....	129
plumbing and leveling forms.....	129
reinforcing steel.....	130
retaining walls, waterproofing.....	134
rubble concrete.....	130
sheet piling, lagging and bracing..	128
surface finish, class 1.....	133
surface finish, class 2.....	133
surface finish, class 3, gunite.....	133
surface finish, class 4, stucco dash	133
surface finish, ordinary.....	132
ties for forms.....	129
tile drains.....	128
waterproofing, retaining walls.....	134
wetting forms.....	129
Concrete, transit mix (see Central Mixing Plant)	
Concrete, vibration of.....	130
Conditions, Contractor's working....	12
Conduit—	
asbestos-cement.....	145
bends.....	144
fiber.....	145
in basement.....	144
installation of.....	144
steel.....	145
Conduits and fittings, electrical.....	141
Conduits, steel, bonding and ground- ing.....	150
Conflicting parts of Specifications....	20
Conform pavement.....	96
Conform to existing pavement.....	120
Construction joints—	
armored concrete curb.....	76
concrete pavement.....	86
concrete sewers.....	107
type "A" concrete base.....	88
Contact joints, type "A" concrete base.....	88
Contract—	
award of.....	16
cost, definition of.....	7
default of.....	32
definition of.....	7
execution of.....	16

Index

	Page		Page
Contractor—		D	
cooperation of	25	Damage to work or property.....	29
definition of	8	Damages—	
failure to perform.....	32	liquidated	18
to check plans	25	responsibility for.....	20
to furnish drawings.....	26	Dams in sewers.....	105
Contractor's—		Day, definition of	8
drawings, sizes of.....	26	Default of contract.....	32
employees	27	Definitions of terms.....	7
estimate	25	A.A.S.H.O.	7
name on concrete pavement.....	86	Approximate, Approximately.....	7
name on curb.....	77	A.S.T.M.	7
name on sidewalk	82	Bidder	7
office, location of.....	27	Cement; Concrete	7
other	25	Charter	7
registration	11	City	7
representative on the work.....	27	City Engineer, or Engineer.....	7
working conditions	12	Contract	7
Contract, proof of compliance with	24	Contract cost	7
Control of the work.....	22	Contractor	8
Convenience of the public.....	34	Date of acceptance.....	8
Cooperation	25	Day	8
Copyright	21	Department of Public Works or	
Corporation Yard	31	Department	8
Corrugated metal pipe.....	53	Director of Public Works or Di-	
Cost data, Contractor's	25	rector.....	8
Cost plus (see Extras).....	36	Inspector.....	8
Countersunk holes in timber, treat-		Plans	8
ment of	124	Provided, Specified.....	8
Covers, manhole	116	Section, Subdivision.....	8
Creosoted lumber, handling.....	122	Specifications.....	8
Creosote, penetration of.....	122	The work.....	9
Creosoting timber and piles.....	121	Ton	9
Crown on street pavement.....	73	Defective castings furnished by	
Culverts—		City, A.W.S.S.	184
C.M.P.	53, 113	Defective work and materials.....	23
connecting to existing.....	109	Defense of City by Contractor.....	21
measurement	35	Delays, liquidated damages for.....	18
sealing of	118	Department—	
V.C.P.	113	of Electricity Yard.....	149
Curb—		of Public Works, definition of.....	8
and gutter, combined.....	78	Deposit for Specifications.....	9
bar	48	Depressed curb for driveway.....	76
concrete, armored	75	Depth—	
concrete, unarmored	77	pipe trench, A.W.S.S.....	176
Contractor's name on.....	77	side sewer	112
depressed for driveway.....	76	Detour routes.....	28, 34
inlet	117	Diatomaceous earth	41
measurement of.....	35	in concrete (see Concrete)	
redwood.....	80	Dimensions	
to be reset by Contractor.....	74	cast iron pipe.....	159
stone	80	on plans	19
white concrete.....	78	Directed by Engineer.....	19
Curing reinforced concrete sewers		Director of Public Works, Defini-	
and sewer structures.....	107	tion of	8
Cut off, piles	126	Disorderly conduct.....	23, 28
Cutting pipe, A.W.S.S.....	177	Disposal of seepage, storm water	
		and sewage.....	105, 128
		Double spigot pipe, laying, A.W.S.S.	178

Index

	Page		Page
Douglas Fir lumber and timber.....	66	Estimates of progress.....	16
definitions.....	66	Excavation—	
select structural beams and		A.W.S.S.....	176
stringers (1600f).....	69	for electrical work.....	151
select structural framing, joists,		lagging, bracing sheet piling for	
plank and small timbers		sewers.....	105
(1600f).....	68	measurement of.....	35, 71
select structural posts and tim-		provisions for traffic to pass over	120
bers (1200c).....	68	public safety.....	29
stress grades, beginning on.....	68	rock under sewers.....	104
Drainage and sewers.....	104	sewers.....	104
Drains, tile, for retaining walls.....	128	street and highway.....	71
Drain tile.....	52	to be kept dry at all times.....	105
Drawings—		Execution of Contract.....	16
Engineer may furnish additional	26	Existing sewers, side sewers and cul-	
shop.....	26	verts, connection to.....	109
to be furnished by Contractor.....	26	Expansion—	
Drier, paint.....	137	joint filler.....	50
Driving piles.....	125	joints, concrete structures.....	129
Dry rubble walls.....	134	joints for brick pavement.....	92
Dummy joints—		joints for concrete pavement.....	85
for concrete pavement.....	86	Extension of time.....	18
for type "A," concrete base.....	88	Extension of time, no.....	30
E		Extras.....	36
Earth, diatomaceous.....	41	Eyebar, steel.....	57
Elbows, conduit, in lighting stand-		F	
ard foundations.....	146	Fabric, wire.....	59
Electrical—		Fees for patents.....	21
equipment, installation of.....	144	Fiber conduit.....	145
equipment, painting.....	151	Field office for Engineer.....	27
inspection.....	141	Filler, expansion joint.....	50
materials.....	141	Fill, street and highway (see Em-	
structures, concrete for.....	143	bankment)	
tests, street lighting.....	152	Final estimate.....	39
work.....	141	Final payment.....	39
work, excavation, backfill and re-		Fine aggregate.....	41
storing pavement.....	151	Finish, concrete surfaces.....	132
work, rules and regulations.....	141	Finishing—	
Elevations.....	30	armored concrete curb.....	76
Embankment—		concrete pavement.....	84
measurement of.....	35, 72	Fir, Douglas.....	66
street and highway.....	72	Fire alarm boxes, relocation of.....	148
Employees, Contractor's.....	27	Fire boat wharf manifolds, installa-	
Emulsified asphalt.....	48	tion of, A.W.S.S.....	181
armor coat.....	101	Fire Department—	
Engineer—		jurisdiction over A.W.S.S.....	154
definition of.....	7	Yard, A.W.S.S.....	154
field office for.....	27	Fittings, cast iron pipe.....	60
to direct work.....	22	Flagmen to be provided when	
to give line and grade.....	30	ordered by Engineer.....	29
Engineering instruments.....	29	Flooded sand backfill.....	128
Equal quality.....	20	Footings, step.....	127
Equipment, electrical, installa-		Force account.....	37
tion of.....	144	Foremen, workmen, Contractor's.....	27
Equipment, sufficient.....	32	Forms—	
Erasure in proposal.....	9	for concrete ballustrades.....	129
Error in specifications.....	19	for concrete sewers.....	106
Estimate—		for concrete structures.....	128
final.....	39	for type "B" concrete pavement	
of amount of work.....	10	base.....	88
of work to be done.....	10	plumbing and leveling.....	129
progress.....	16	removal of.....	132

Index

	Page
Form ties.....	129
Foundations for lighting standards	146
concrete for	143, 146
Frame and cover for manhole.....	116
Frame and grating for catchbasin....	117
G	
Galvanizing	123
Gate valves, A.W.S.S.....	162
Gauges, A.W.S.S.....	156
Grade—	
line and	30
of V.C.P. culverts.....	113
of side sewer.....	112
Grades—	
laying pipe on, A.W.S.S.....	178
laying sewer pipe on.....	109
Grading—	
of coarse aggregate.....	42
of fine aggregate.....	41
streets and highways	71
Graphite pigment for paint.....	137
Grating for catchbasin.....	117
Gravel, aggregate (see Coarse aggregate)	
Grounding street lighting appurtenances	150
Ground water, removal of, with sub-drains.....	105
Grout	43
Gunitite surface finish.....	133
Gutter and curb, combined.....	78
measurement of.....	35
H	
Hardware—	
for timber structures.....	123
galvanizing.....	123
Headers—	
for concrete pavement.....	83, 84
redwood.....	83
High pressure hydrants, A.W.S.S.....	166
bronze castings for.....	167
drawings furnished by City.....	166
iron castings for.....	167
machine steel	168
marking hydrant parts.....	166
painting.....	168
patents.....	166
steel, machine.....	168
tests on	168
tobin bronze	167
workmanship	166
wrought iron.....	168
Highway Grading	71
Highways and Streets	71
Holes in timber for bolts, lag screws, etc.....	124
Horizontal measurements	35
Hours of labor.....	12
House sewers, connections (see Side sewers)	

	Page
Hydrants—	
high pressure, A.W.S.S.	166
installation of, A.W.S.S.	180
Hydrated lime	41
Hydrostatic tests—	
on cast iron pipe, A.W.S.S.	161
on facilities after installation, A.W.S.S.	182
I	
Illumination of work	28
Implied parts of the work	20
Improvement	13
Improvements, restoration of	33
Incidental work—	
allocation of cost	11
description of typical	31
includes work not mentioned	20
Information for bidders	9
Information prior to receipt of bids	10
Inlets for V.C.P. sewers and culverts	108
Inlets, stub	108
Inspection	22
electrical	141
lumber and timber	61
Inspector, definition of	8
Inspector's services, application for	22
Installation—	
electrical equipment	144
facilities, A.W.S.S.	176
fire boat wharf manifolds, A.W.S.S.	181
hydrants, A.W.S.S.	180
valves, A.W.S.S.	180
Instructions for bidders	9
Instruments, engineering	29
Insurance—	
Public Liability and Property Damage	14
Workmen's Compensation	13
Interpretation of Plans and Specifi- cations	19
Intimidation of the City's employees	23
Invert, brick	107
Investigation by bidder	10
Iron—	
cast, general specification	55
galvanizing	123
wrought	57
wrought, pipe	60
Iron castings for valves, A.W.S.S.	163
J	
Jetting piles	126
Joint compound, bituminous, for sewers	51
Joint filler, expansion joints	50
Joints—	
bituminous for V.C.P. sewers	110
construction, for armored con- crete curb	76
expansion, concrete structures	122

Index

	Page
Joints for concrete pavement.....	85,
construction joints	86
dummy joints.....	86
expansion joints.....	85
Joints for type "A" concrete	
pavement base.....	89
construction joints.....	88
contact joints.....	88
dummy joints.....	88
Joints for type "B" concrete	
pavement base.....	89
construction joints	89
contact joints.....	89
dummy joints.....	89
Joints—	
pipe, melting, A.W.S.S.....	184
pipe, payment for, A.W.S.S.....	179
V.C.P. sewers.....	110
Junction box.....	146
concrete for.....	143
Jute for packing pipe joints,	
A.W.S.S.	175
K	
Key joint (see construction joint)	
L	
Labor, hours of.....	12
Labor saving devices.....	104
Laboratory tests	23
Lagging, bracing, sheet piling—	
for concrete structures	128
for sewers	105
Lagging trenches, A.W.S.S.....	176
Lamp black.....	43
Lampholes.....	116
Lateral sewers, house (see Side sewers)	
Laws and Regulations.....	20
Laying, pipe, A.W.S.S.....	177
Laying, V.C.P. sewers.....	109
Lead, pig, A.W.S.S.....	174
Lead, pouring, for pipe joints,	
A.W.S.S.	179
Leakage, permissible, A.W.S.S.....	183
Length of valves for payment,	
A.W.S.S.	179
Legal address of Contractor.....	16
Legal relations and responsibility of Contractor	20
Lighting standard foundations.....	146
concrete for.....	143,
146	
Lighting standards, erection of.....	146
Lighting standards, metal, paint for.....	142
Lime, hydrated.....	41
Line and grade.....	30
Linseed oil.....	137
Liquidated damages	18
Liquors, spiritous	24
Loam to be preserved for backfill.....	127
Loose measurement.....	35
Losses and damages.....	7
Low bidder.....	7

	Page
Lumber	61
Douglas Fir.....	66
measurement	36
Redwood	61
sizes	62
stacking of	124
wasted, no payment for.....	36
Luminaires, street lighting, installation of	148

M

Macadam—	
oiled surface for.....	100
sidewalk.....	103
waterbound	98
Maintenance.....	33
Maintenance Yard, A.W.S.S.....	154
Manhole—	
castings, resetting.....	72
frames and covers	116
steps.....	116
Manholes	114
abandoning.....	118
paving at.....	74
procedure at during street con-	
struction	74
Public Utility, access to.....	150
special	115
Manufacturer.....	20
Material substitution	24
Materials—	
defective.....	23
furnished by City, A.W.S.S.....	154
general.....	40
general, A.W.S.S.	153
handling, A.W.S.S.	154
owned by City, responsibility for,	
A.W.S.S.	155
return of, to Maintenance Yard.	
A.W.S.S.	155
to be first class.....	22
Measurement and payment.....	35
Measurement of quantities.....	35
Measurement, truck	35
Membrane, for curing concrete.....	47
Mesh, wire	59
Mixing concrete.....	45
Mixing Plant, concrete (see Central	
Mixing Plant)	
Mixing time for mortar (see	
Mortar)	
Monuments, City.....	30
Mortar	43
Multiple curb inlet.....	117

N

Negligence, responsibility.....	21
Night work.....	28
Nipples, cutting and marking, A.W.S.S.	177
Nuts, cutting threads after galvan- izing	123
Nuts, galvanizing	123

Index

	Page		Page
O		P	
Oakum, A.W.S.S.....	175	Paint	137
Office of Contractor, location.....	27	aluminum	138
Oiled surface for macadam.....	100	application of.....	136, 138
Omission from specifications.....	19	for metal lighting standards.....	142
One course sidewalk, concrete.....	82	graphite	137
Opening bids	9	mixing	138
Overtime work, Engineer to be notified in advance.....	28	red lead	137
		white lead.....	138
		Painting	136
		electrical equipment.....	151
		Patents	21
		Patterns, A.W.S.S.	156
		Patterns to be delivered to Corporation Yard	31
		Pavement base, concrete—	
		type "A" (6" thick).....	87
		type "B" (8" thick).....	88
		Pavement—	
		at manholes.....	74
		brick	91
		center strip, concrete.....	90
		concrete.....	83
		concrete, headers for	83, 84
		conform.....	96
		crown, street	73
		excavation	71
		headers, redwood.....	83
		measurement of.....	35
		mesh reinforcement for	59
		restoration of	119
		subgrade	73
		Pavements, restoration of—	
		A.W.S.S.	177
		electrical work.....	151
		Pavements, temporary.....	34, 120
		Paving brick	52
		Payment	38
		may be withheld	17
		rejection after	23
		Payments, progressive.....	17
		Payrolls, access to.....	25
		Penetration of creosote.....	122
		Permissible leakage, A.W.S.S.....	183
		Pig lead, A.W.S.S.....	174
		Pile heads, treatment of.....	126
		Piles—	
		concrete.....	124
		creosoting	121
		driving.....	125
		measurement of.....	36
		preparation for creosote.....	121
		Piles—Continued	
		preservation of	121
		pressure treatment processes.....	121
		splices	126
		timber	70
		timber, cut off	126
		timber, dimensions of.....	70
		Piling, sheet	105
		Pipe—	
		anchoring in place, A.W.S.S.....	179
		cast iron, and fittings.....	60
		cast iron, A.W.S.S.....	157
		cast iron, A.W.S.S., tests on.....	161
		cleaning before laying, A.W.S.S.....	178
		connecting to existing, A.W.S.S.....	179
		corrugated metal	53
		joints, lead, melting out.....	184
		joints, making B & S, A.W.S.S.....	178
		laying, payment allowance for extra joints, A.W.S.S.....	179
		lengths, A.W.S.S.....	158
		marking, A.W.S.S.....	177
		measurement of for payment.....	179
		sewers, vitrified clay.....	109
		testing of at Maintenance Yard, A.W.S.S.	155
		trenches, A.W.S.S.....	176
		vitrified clay.....	52
		Pits, test, A.W.S.S.....	176
		Planimeter for measuring areas.....	35
		Plans—	
		cash deposit for.....	9
		definition of	8
		Engineer may furnish additional.....	26
		interpretation of	19
		to be checked by Contractor.....	25
		to be furnished by Contractor.....	26
		Plaster facing for armored concrete curb	76
		Plowing slope.....	72
		Plumbing and leveling forms.....	129
		Pole riser.....	150
		Police telephone boxes, relocation of.....	148
		Portland cement	40
		Portland cement concrete.....	44
		Possession by City before acceptance	21
		Possession of work on default.....	32
		Precast concrete piles.....	124
		Precautions to prevent damage, etc.....	29
		Primary street lighting cable.....	147
		Private property, damage to.....	27
		Procedure at manholes.....	74
		Profits, anticipated	37
		Progress estimates.....	16
		Progressive payments.....	17
		Progress schedule	25
		Property, damage to.....	29
		Proposals	9
		Protecting and curing concrete.....	47
		Public Safety and Convenience.....	34

	Page		Page
Public Utility manholes and vaults, access to	150	Road oil	100
Public Work	13	Rock—	
Public Works, Department of, definition	8	for coarse aggregate	42
Pullboxes	146	for tile drains	114
concrete for	143	subgrade for sewers to be replaced	104
Punctuation marks in Specifications	19	Rods, reinforcing (see Reinforcing steel)	
Q		Rubbish, disposal of	32
Qualification of bidders	11	Rubble concrete	130
Qualified bids	9	Rubble walls—	
Quantities, measurement	35	dry	134
		mortared	135
R		S	
Radii of conduit bends	144	Safety and convenience of the public	34
Red lead	137	Safety of traffic, provisions for	28
paint	137	Salvaged materials, delivery to Cor- poration Yard	31
Reducers, payment for laying, A.W.S.S.	179	Sand	41
Redwood—		Sand backfill, flooded	123
curb	80	Sanitary conveniences	27
headers	83	Screenings, macadam	93
stress grades, beginning on	63	Section, Subdivision, definition of	8
Redwood lumber and timber	61	Seepage, disposal of	105, 128
bulkhead structural (1100f)	65	Sewage, disposal of	105
definitions	61	Sewer—	
dense select all-heart structural (1400f)	63	backfill over	119
sizes	63	brick for invert (see Vitrified brick)	
Registration of Contractor	11	joint compound, bituminous	51
Reinforced concrete—		structures, reinforced concrete	106
piles	124	vents, resetting	72
sewers	106	Sewers—	
structures	127	abandoned	118
Reinforcement, mesh	59	and drainage	104
Reinforcing steel	58	backfill	119
bars, weight of	60	connection to existing	109
for concrete structures	130	excavation for	104
Rejected material, removal of	24	excavation of rock under	104
Rejection of work	23	measurement of	35
Replacement of unsuitable subgrade for sewers	104	pipe, sealing of	118
Required, as	19	reinforced concrete	106
Resetting manhole and catchbasin castings, etc.	72	side	112
Responsibility—		vitriified clay pipe	52, 109
for City material, A.W.S.S.	155	Sheet piling, lagging and bracing—	
of the Contractor	20	for concrete structures	128
Restoration of improvements	33	for sewers	105
Restoring pavements	119	Shop drawings	26
electrical work	151	Shrubs to be removed and replaced ..	128
A.W.S.S.	177	Side sewer and Y-branch marks on curb	71, 112
Retaining walls—		Side sewers	72, 112
tile drains for	128	connection to existing	109
waterproofing	134	existing, specifications governing during street construction	72
weepholes for	128		
Right of way, lack of	18		
Riser, pole	150		
Rivet steel	57		

Index

	Page		Page
Sidewalk—		Street pavement crown.....	73
concrete, one course.....	82	Streets and highways.....	71
concrete, two course.....	81	Streets, use of by the Contractor.....	28
Contractor's name on.....	82	Stress grades—	
macadam.....	103	Douglas Fir.....	68
measurement of.....	35	Redwood.....	63
Slab, concrete, over trench, A.W.S.S.	184	Structural steel.....	57
Sleeves for B & S pipes, installation		galvanizing.....	123
of, A.W.S.S.	178	materials.....	135
Slopes to be plowed.....	72	Structures—	
Special manholes.....	115	abandoned.....	118
Special Provisions, definition of (see		and miscellaneous.....	121
Specifications).....	8	backfill.....	119
Specifications—		concrete.....	127
addendum to.....	11	for sewers, reinforced concrete.....	106
cash deposit for.....	9	Stub inlets.....	108, 116
conflicting parts.....	20	Stucco dash finish.....	133
definition of.....	8	Sub-contracts.....	15
interpretation of.....	19	Subdivision, Section, definition of.....	8
Spirituous liquors.....	24	Subdrains.....	106
Splicing—		Subgrade—	
piles.....	126	for pavement.....	73
reinforcing steel.....	59	replacement of, for sewers.....	104
street lighting cable.....	148	unsuitable, for sewers.....	104
Spray coat, asphaltic cement.....	93	Substitution of materials, etc.....	24
Stakes, survey.....	30	Subsurface improvements—	
Standards, lighting, paint for.....	142	damage to.....	29
State laws.....	20	maintenance.....	33
Steel—		Sunday work.....	28
castings.....	56	Superintendent, Contractor's.....	27
conduit.....	145	Supervision of work.....	22
eyebar.....	57	Surface—	
for valves, A.W.S.S.....	165	asphaltic concrete.....	88
galvanizing.....	123	preparation of for painting.....	138
measurement of.....	36	Surfaces for macadam, oiled.....	100
reinforcing.....	58	Survey stakes—	
rivet.....	57	Contractor to haul.....	27
structural.....	57	setting, preserving.....	30
structures.....	135	Suspension of work.....	18
structures, materials for.....	135		
Step footings.....	127		
Steps for manholes.....	116		
Stone—			
curb.....	80		
dust.....	50		
for rubble concrete.....	130		
Stop signs, arterial, relocation of.....	149		
Storm water, disposal of.....	105, 128		
Storm water inlet.....	116		
Street grading.....	71		
Street lighting cable.....	142		
cutting and splicing.....	147		
installation of.....	147		
tests on.....	152		
Street lighting—			
luminaires, installation of.....	148		
standards (City owned) reloca-			
tion of.....	149		
work, materials for.....	141		
Street names—			
on curb.....	77		
on sidewalk.....	82		

Index

	Page
Tie wire for reinforcing steel.....	58
Ties for forms.....	129
Tile, drain.....	52
Tile drains.....	114
for retaining walls.....	128
Timber.....	61
creosoting.....	121
measurement of.....	36
piles.....	70
preparation for creosote.....	121
preservation of.....	121
pressure treatment processes.....	121
stacking of.....	124
structures.....	123
Timbering, lagging, sheet piling, bracing.....	105
Time—	
essence of contract.....	32
extension of.....	18
of mixing mortar (see Mortar)	
Ton, definition of.....	9
Track excavation (see Pavement excavation)	
Trade mark.....	21
Trade names.....	20
Traffic—	
maintaining.....	28
markings to be replaced.....	120
provisions for safety of.....	28
signals, relocation of.....	148
Transite conduit.....	145
Trap—	
catchbasin.....	117
side sewer.....	112
Trench—	
concrete slab over, A.W.S.S.....	184
lagging and bracing.....	105
Trenches, A.W.S.S.....	176
Truck measurement.....	35
Turnbuckles, tie rods, bolts, etc., A.W.S.S.....	174
Turpentine.....	137
Two course sidewalk, concrete.....	81
U	
Unarmored concrete curb.....	77
Unbalanced bids.....	9
Underdrains (see Subdrains).....	106
Underground conditions.....	10
Use—	
of the work before acceptance.....	21
of work is not acceptance.....	21
Utilities—	
interference with.....	26
public, records.....	10
V	
Valve boxes—	
A.W.S.S.....	182
resetting.....	72
Valve vaults, A.W.S.S.....	182

	Page
Valves—	
air, A.W.S.S.....	180
installation of, A.W.S.S.....	180
laying length for payment, A.W.S.S.....	179
Valves, gate and check, A.W.S.S.....	162
bronze castings for.....	163
bronze, tobin.....	164
drawings.....	162
gears.....	163
iron castings for.....	163
iron, wrought.....	165
marking valve parts.....	165
painting.....	166
reinforcement for bells.....	162
samples.....	162
sizes.....	162
steel.....	165
stuffing boxes, packing.....	163
tests.....	165
tobin bronze.....	164
workmanship.....	162
wrought iron.....	165
Vaults—	
Public Utility access to.....	150
valve, A.W.S.S.....	182
Vents, sewer, resetting.....	72
Vibration of concrete.....	130
Vitrified brick.....	51
Vitrified brick invert.....	107
Vitrified clay pipe.....	52
culverts.....	113
sewers.....	109
W	
Wages, rate of.....	12
Waiver of legal rights, no.....	21
Walls—	
dry rubble.....	134
mortared rubble.....	135
tile drain for drainage of.....	128
Warning signs for traffic.....	28
Washers, galvanized.....	123
Watchmen.....	29
Water.....	43
storm, disposal of.....	105
Waterbound macadam.....	98
Water trap for catchbasin.....	117
Waterproofing retaining walls.....	134
Wearing surface, asphaltic concrete.....	93
Weather, bad.....	18
Weepholes for retaining walls.....	128
Weight of reinforcing steel bars.....	60
Weights of cast iron pipe, A.W.S.S.....	159
Welded wrought iron pipe.....	60
Welding structural steel.....	136
Wetting forms.....	129
Wharf manifolds, fire boat, installa- tion of, A.W.S.S.....	181
White concrete curb.....	78

Index

	Page		Page
White lead	138	Working conditions	12
White lead paint.....	138	Workmen, Contractor's	27
Width of pipe trench, A.W.S.S.....	176	Workmen's Compensation Insur-	
Wire—		ance	13
binders, A.W.S.S.	174	Wrought iron	57
fabric.....	59	pipe	60
tie, for reinforcing steel.....	58		
Work—		Y	
acceptance of part of.....	22	Yard, City, Corporation, delivery of	
access to	22	salvaged materials and pat-	
commencement and prosecution of	24	terns to	31
control of	22	Yard, Maintenance, A.W.S.S.....	154
date of acceptance, definition.....	8	Yarn, A.W.S.S.	175
defective.....	23	Y-branch—	
definition of.....	10	location to be marked on curb.....	77
inspection of.....	22	no deduction for.....	35
not inspected, rejection of.....	23	on V.C.P. sewers.....	108
not mentioned in plans or specifi-			
cations.....	20	Z	
suspension of	18	Zinc oxide.....	137
to be kept clean at all times.....	32		

Memorandum

Memorandum

Memorandum

Memorandum

16) 84 /
8
12

